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VOL. 40, No. 2, 1957

THE

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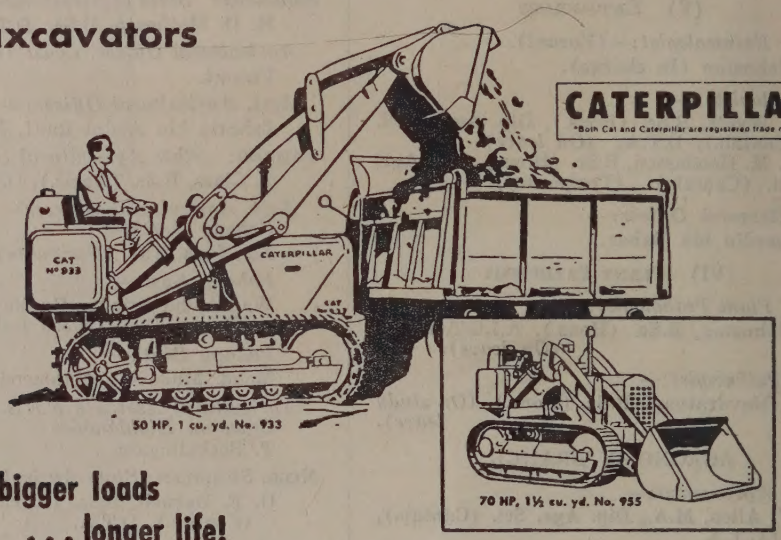

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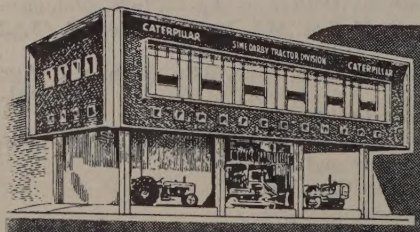

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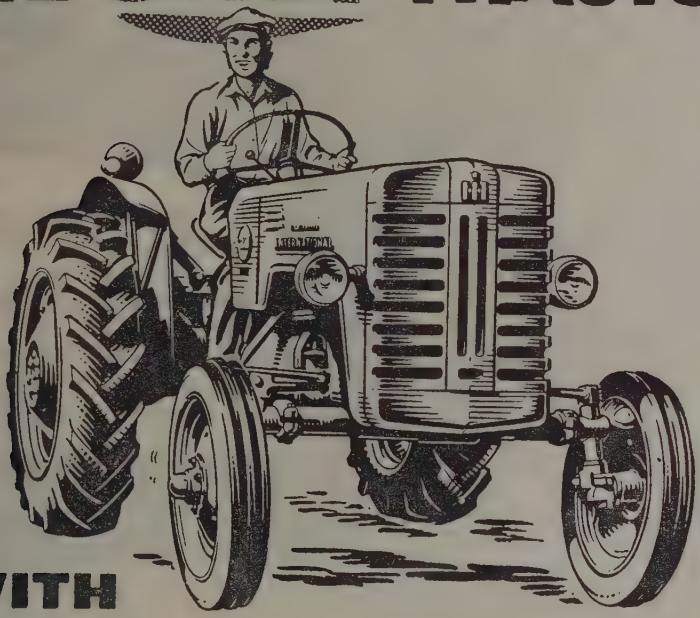

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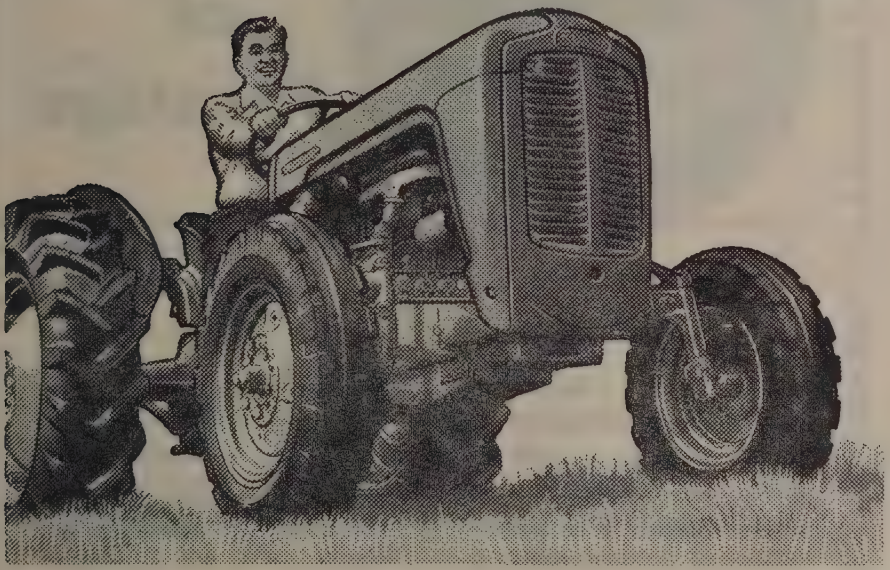

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THE MALAYAN AGRICULTURAL JOURNAL

The Journal is designed to present—as far as possible in non-technical terms—the results of the agricultural research, investigation and extension work in Malaya performed by the Department of Agriculture. Also, by means of selected articles, abstracts and reviews, this publication draws attention to the results of work of a similar nature in other countries, which have a bearing on agriculture in Malaya.

The Department of Agriculture does not necessarily recommend the use of any product advertised in the Journal by commercial firms.

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Malayan Agricultural Journal
Vol. 40, No. 2, 1957

EDITORIAL

Soil Survey Report A sixth report on soil surveys carried out by the Department of Agriculture is presented in this edition. Previous reports have covered portions of the Trans-Perak Swamp, the Kuala Langat Forest Reserve and western Singapore Island, as well as two Federal Experiment Stations.

The survey reported herein by Mr. Arnott was carried out in Kelantan in 1955 at the request of the Kelantan Government; it covered 60,000 acres of sparsely settled land lying south of Kota Bharu, on which the vegetation was sparse, the soil was visibly poor, and crop yields were markedly lower than those on the adjacent Kelantan Plain.

The survey showed that about 70 per cent of the area consists of poor soils; pot experiments suggest that they are deficient in a number of elements, including phosphorus, magnesium, calcium and some minor elements. The survey clearly indicated that large scale development should be preceded by investigations into means of improving and conserving soil fertility, but the author suggests that with the correct management a considerable proportion of the surveyed area can be put under fruit and rubber.

This survey, like others before it, illustrates that the opening up of large areas of new land in Malaya is not a simple procedure of clearing jungle vegetation and planting crops, for in general Malayan soils are not rich and much effort, hard thinking and hard work are required to bring undeveloped areas into more-than-marginal production.

Survey of Padi Farms in Lower Perak The first stage in the development of the Sungei Manik area of Lower Perak was undertaken by the Government twenty-five years ago. A recent economic survey of parts of this area, reported by Mr. Wilson, provides some of the basic type of information which is important in the planning of large scale development of new padi lands. The survey, although brief and incomplete, gives an interesting glimpse into the economics of the established padi farm—size, fragmentation, and rental practices—and indicates the direction in which newly-developed areas may be expected to evolve.

Padi Nutrition The utilisation of soil nutrients by dry land crops has been studied by many investigators in a large number of countries, but the uptake of nutrients by padi grown in waterlogged conditions is not so well understood. In "Mineral Nutrition of Padi", Mr. Kanapathy describes experiments carried out in Australia on the uptake of nitrogen and phosphorus by padi and he discusses this work in relation to the results of other investigators who studied the nutrition of oats and clover grown on the same type of soil.

SOIL SURVEY REPORTS.
No. 6, THE KELANTAN DEFICIENCY AREA

BY

G. W. ARNOTT,

Chemist (Soils)

GENERAL DESCRIPTION OF THE AREA

Introduction

The Kelantan Deficiency Area is situated on the western side of the Kelantan River about 10 miles south of Kota Bharu. The Kelantan Plain stretches from the coast to between 10 and 15 miles inland and the Defiicency Area referred to in this report marks the beginning of the higher ground to the south of the Plain.

The term "deficiency area" probably arose because cattle in certain parts of the area showed signs of a bone disease called *penyakit pari*, which involves a swelling and brittleness of the bones. The Department of Veterinary Services made a preliminary investigation of this disease and found that it occurred in lactating animals after the second or third lactation and that it did not occur in male animals. Blood analyses showed low phosphate and calcium contents and dosage with mineral mixtures gave some improvement in health.

From this information it may be deduced that the pasture within the area is of poor quality and that there is some justification for the term "deficiency area".

About 1950, the State Agricultural Officer, Kelantan, suggested that alienation of land in this area should be stopped until an answer to the deficiency problem had been found. It was hoped that, afterwards, planned development of the area could take place.

In July, 1954, Coulter and Panton of the Soil Science Division visited the area in order to define the problems of the deficiency area and to suggest what future surveys etc. should be made. They recommended (1) that a soil survey should be carried out and they delineated an area for survey which would require about four months' work.

On these terms of reference, a soil survey of the area was carried out during the latter half of April and the months of May and July, 1955. There was not sufficient time to complete the survey as originally planned and most of the available time was devoted to the more important areas.

Location

The area recommended for the soil survey was that bounded by the Pasir-Mas-to-Tanah-Merah railway line on the east, the Tanah-Merah-to-Kampong-Jedoh road on the south, the Sungei* Tasik Gharu on the west and the Pasir-Mas-to-Rantau-Panjang railway line on the north. The area mapped totalled about 60,000 acres.

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* Sungei = River.

Physical Features

The landscape can be divided into three main regions. In the south-west is a region with hills up to 200 ft. in elevation while in the north and south-east the land is mainly flat. The remaining area between the north and south is gently undulating, lies between 25 and 60 ft. above sea level and is considered as the deficiency area terrace. There are lower terraces along the banks of some of the streams.

Geology

The hills in the south-west of the area consist of Triassic rocks of mixed composition including shales and quartzites. There are occasional small outcrops of these rocks rising to about 10 to 20 ft. above the main deficiency terrace. The terraces themselves are composed of alluvial-colluvial material which is probably of Triassic origin.

More recent alluvial deposits cover the surrounding lower lying areas. The Kelantan Plain has been formed from material of granitic origin and, where this fringes the surveyed area, better soils are found. The alluvium in the north of the area consists of river deposits from poorer areas of quartzites and shales.

Climate

The climate is uniform over the area, with mid-day temperatures between 81°F. and 88°F. and an annual rainfall of about 120 in. There is a well-marked wet monsoon season in the months of October, November and December and a dry season in February, March and April.

Vegetation

There are five main types of vegetation within the area surveyed; they are:-

(i) poor jungle with belts or patches of gelam (*Melaleuca leucadendron*) which are sometimes pure stands and sometimes mixed. This type occurs in the lower, swampy and often peaty areas in the north-west;

(ii) average quality mixed jungle on the hills in the south-west;

(iii) open grassy areas or "park-land" with occasional termite mounds. Clumps of trees, such as halban (*Vitex pubescens*), or clumps of secondary jungle growth often grow out of these mounds. The grass cover is poor, short rumput jenaris (*Ischaemum imbricatum*);

(iv) secondary jungle growth containing kedudok (*Melastoma sanguineum*), kemunting (*Rhodomyrtus tomentosa*), bamboo clumps and small trees such as tembusu (*Fagraea fragrans*). On some of the sandier soils the secondary jungle growth is often mixed with a very thick growth of ferns; and

(v) open "hog-wallowed" areas with occasional termite mounds from which grow clumps of trees and/or bushes. The grass cover is usually long rumput jenaris. The term "hog-wallowed" refers to a very uneven, much-channelled and hillocky terrain. The phenomenon found in the deficiency area appears to be similar to the Australian "lattice" or "network" *gilgai** described by Hallsworth *et al* (2).

The swamp jungle has a very uneven surface because the trees build up small islands of vegetation and the hollows remain waterlogged. The result is very similar to the "melon-hole" *gilgai* noted by Hallsworth. When the jungle is cleared the surface becomes fairly level and grass (rumput jenaris) predominates. The soil is waterlogged during the wet season. It dries out and cracks in the dry season, and small clods break off and fall to the bottom of these cracks. When the soil is rewetted, pressure is exerted and this tends to force up blocks of soil. These blocks are stabilised by a vigorous growth of rumput jenaris and the channels between them (6 to 12 in. wide and about 1 ft. deep) are quite bare.

Trees in the forested area of the south-west are very often affected by "brittle heart" and thus yield low quality timber. One theory advanced as a possible explanation of the occurrence of "brittle heart" is that the trees developed very rapidly in areas where the existing forest had been damaged severely by storms and the rapid growth produced unsound timber. It has also been suggested that boron deficiency exists, but as yet there is little direct evidence to support this theory.

In general, both types and growth of vegetation are poor—a direct reflection on the soil.

Agriculture

Agricultural development throughout the area is very sparse and scattered. Attempts to cultivate padi have been widespread but generally unsuccessful. Low yields of about 50 *gantangs* (gallons) per acre are obtained and many padi fields have been abandoned. Padi cultivation is now confined to the more fertile soils of the Kelantan Plain Series and to the alluvial strips along river banks. Dry padi is grown to a small extent.

Rubber is grown on the freely drained sandy soils (the Lati Series) and on the Malacca Series soil occupying the hills in the south-west of the area.

There are also many smallholdings with mixed crops, especially on the upper terrace, and some of these are probably unauthorised squatter-establishments. Small patches of jungle have been cleared and rubber, pine-apples (Mauritius and Sarawak varieties), tapioca and water-melons are now grown. The land is very poor and crops such as pineapples take a long time to reach maturity. They are of excellent quality, however, and are very sweet.

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* *gilgai* = an Australian aboriginal word for a small water hole.

Method of Survey

Field Methods

In their preliminary survey, Coulter and Panton identified the main soils groups within the area. The present survey was carried out using this group basis and by identifying soil series within the groups. Because of the difficult nature of the terrain, which often consisted of swamp with thorny vegetation, secondary jungle with much undergrowth, and areas of bamboo, traces were cut in an east-west direction at intervals of one mile. The soils were examined along these lines and the various series differentiated. This may not be the most desirable method of survey but it was the best possible in the prevailing circumstances.

Aerial photographs and field notes were used to construct a vegetation map on a scale of 2½ in. to the mile and these, plus soil-survey notes, were used to draw in the boundaries between soil series. It must be remembered that soil series merge with each other and it is not always possible to draw in boundaries with great accuracy. The boundaries lying between the trace lines have been filled in by extrapolation, very often along vegetation boundaries. This method leads to inaccuracies when surveying alluvial soils but, as has been said, it is the best that could be done in the time available.

Soil Classification

The soil series is the primary soil unit both for mapping in the field and for classification. Eight different series and two associations have been mapped. Soil profiles of each series have been examined and descriptions are given later in this article.

The standard terms used in these descriptions are similar to those used in the U.S. Department of Agriculture Soil Survey Manual (5). The slope classes used in this report, also, are similar to those in (5) and they are as follows:-

Slope A.	0 – 3 per cent.	Level or nearly level soil areas on which run-off is slow or very slow;
Slope B.	3 – 8 per cent.	Gently undulating, undulating or gently sloping soil areas in which run-off is slow or medium for most soils; and
Slope C.	8 –16 per cent.	Gently rolling, rolling or moderately and strongly sloping soil areas on which run-off is medium to rapid for most soils.

Soils

Factors Influencing Development

The factors affecting the formation of the major soil groups are climate, parent material, relief, vegetation and time (3).

Within the area surveyed the climate is uniform. The high temperature and rainfall cause more rapid soil weathering, leaching and erosion than occur in temperate zones. Many of the deficiency type soils occupy sites where there is little accumulation of fresh soil material and the heavy leaching has produced senile soils with low nutrient contents.

The parent materials of the soils in the south-west region are shales and quartzites on which the Malacca and Kedah Series have developed. The parent materials are poor and the soils are of low fertility. The upper terrace on which the worst soils are found begins at about milestone 18 and ends at milestone 26 on the Kampong-Pusu-to-Tanah-Merah road, and is about six or seven miles wide. Along the banks of some of the streams there are lower terraces with slightly better soils on which some padi is cultivated. Soils such as the Kampong Pusu Series, which occurs on lower ground, have been formed from poor alluvium and it is only on the fringes of the area that we find the better alluvial soils of the Kelantan Plain type which have been formed from the more recent depositions of the Kelantan River.

The effect of relief or topography on soil type has been mentioned above. Senile soils have developed on the raised terraces, shallow soils are found on the upper hill slopes and deeper, better soils occur on the lower slopes where the erosion material is deposited. In the flat areas of the north, hydromorphic soils have developed, and peat and muck soils have formed in the depressions left by old river systems.

It is unlikely that vegetation has had much effect on soil type but probably the reverse effect has occurred and the soil type has influenced vegetation. Gelam and jungle have developed on the acid peats and mucks, bamboo occurs on the very sandy and freely draining soils of the upper terrace, and open savannah with patches of secondary jungle growth and clumps of trees is predominant on the poor clay soils of the area.

Time has had the effect of ageing most of the soils, in that the soil-forming factors have been at work for a very long period and the soils have become senile.

Description of Soil Series

Eight soil series and two associations, which have not been divided into series, have been mapped. Of these, five fall into the deficiency class and together they cover about 60 per cent of the total area surveyed.

The soil series are:-

Kampong Pusu, Kampong Cherang Hangus, Padang Gong Chenak, Kampong Lubok Kiat, Bukit Tuku,	Deficiency soils.
Malacca, Lati, and Kelantan Plain.	Better soils.

The soil associations are:-

Malacca-Kedah and
Peat and muck.

KAMPONG PUSU SERIES

This is one of the better of the deficiency type soils and occupies 7,500 acres in the low-lying areas, mainly in the north and south.

Soil Profile

A soil pit was dug in Field 3 at Kampong Pusu Experiment Station and the description is as follows:-

Area under rumput jenaris and the stubble of a dry padi crop; slope, A; and profile moderately well drained.

0 – 1 in. Black sandy clay loam with weak, medium crumb structure; plenty of grass roots; free aeration and drainage.

1 – 5 in. Black sandy clay loam with fine subangular blocky structure; boundary with the above horizon is indistinct; friable consistence; fewer roots and drainage imperfect; faint yellow mottles at 5 in. depth.

5 –12 in. Distinct boundary at 5 in.; dark grey (5Y 4/1) sandy clay with frequent small rust mottles; fine subangular blocky structure; few roots and imperfect drainage.

12 –23 in. Light grey (5Y 7/2) sandy clay loam with rust mottles frequent; subangular crumb structure.

23 –35 in. White (5Y 4/8) clay matrix with medium, common red (7.5R 4/8) mottles; non-structured and compact.

35 –48 in. As above with some coarse mottles; many orange and red mottles medium and prominent; structureless; drainage poor and no roots.

Fertility

Analyses show low phosphorus and potassium except in the top 1 in. It can be said that the fertility of this soil is closely connected with the organic matter content of the surface layer. Although it is topographically suitable for padi, the soil is not fertile and this and the problem of irrigation have to be overcome for wet padi cultivation. The best vegetative response in field experiments has been obtained from farmyard manure, and the pot experiments bear this out. Irrigation would be difficult except by small pumping schemes, and the possibility of dry padi cultivation should be borne in mind.

The soil found in the south of the area, at Padang Siam, has been included in this series because it has many basic similarities. It differs in not having such a well developed organic horizon as the Kampong Pusu type.

LATI SERIES

This soil occurs mainly in the north-east part of the area and occupies about 5,000 acres. It has been formed from the sandy alluvium deposited by the Kelantan River.

Soil Profile

In old rubber plantation; badly kept rubber with much secondary jungle growth; slope, A; moderate drainage and permeability. Surface covered by a thin layer of decomposing leaves and twigs.

0 – 1 in.	Dark grey-brown, coarse sandy clay loam; more or less structureless with free drainage; roots common; friable consistency; slightly sticky when wet.
1 – 3 in.	As above with few roots.
3 –14 in.	Brownish-yellow sandy clay loam with a little organic staining and very few roots; moderately dry; massive structure.
14 –30 in.	As above, with a few, faint rust mottles.
30 –48 in.	Light grey sandy clay loam matrix with rust-coloured streaks and distinct medium, light red mottles; non-sticky, slightly plastic; loose consistency. There are a few brown speckles which are probably due to manganese concretions, and small flakes of mica are common in the lower horizons.

The horizon boundaries are diffuse except at 3 in., where the boundary is abrupt and smooth. Drainage in the upper layers is free and in the lower horizons, slightly imperfect.

Fertility

Analyses show very low phosphorus and potassium contents except in the 0–3 in. layer, where the figures are medium. Carbon and nitrogen contents are also low except in this layer.

Nearly all this soil has been planted with rubber. It is a younger soil than most of the others in the area but it is not of high fertility and its value lies more in its structure, which is most suitable for tree crops such as rubber. Most of the trees appear to be very old and it would be of benefit to replant with young rubber. However, care must be taken to preserve the organic layer and it would be desirable to apply fertilisers.

MALACCA SERIES

This soil occurs in the hilly parts in the middle and south-western parts of the area and occupies about 6,000 acres. It is a very common soil throughout Malaya and in this area is formed over shales of Triassic age. Various profiles show differences in the thickness of the horizon immediately above the laterite band and this is linked to the topographical position of the soil and its degree of erosion. This series occurs on B and C slopes in the area.

PLATE I

Open area with poor grass cover on Kampong Pusu Series soil.

PLATE II

Felled jungle on Malacca–Kedah Association soils.

PLATE III

Felled jungle on Kampong Cherang Hangus Series soils.

PLATE IV

Pineapples etc. on Bukit Tuku Series soil.

Profile

The pit was situated on a B slope in an area which had been cleared recently of secondary jungle growth prior to rubber planting.

0 – 1 in. Dark brown sandy loam with numerous roots; free draining; fine, moderate crumb structure; diffuse boundary to next horizon.

1 – 6 in. Brown sandy clay loam with darker patches of organic staining common and roots plentiful; structure as above with a slightly plastic consistency; diffuse boundary between this and next horizon.

6 –16 in. Yellowish-brown to brownish-yellow sandy clay loam with few roots; massive structure; slightly plastic; quartz particles are common.

16 –27 in. As above with a few laterite concretions at 20 in.

27 –36 in. Brownish-yellow sandy clay loam matrix with many medium and coarse lateritic concretions; very few roots.

The profile is fairly freely drained and shows no signs of mottling.

Fertility

Except for the top 6 in., the analysis figures are low and the soil is of low fertility. However, rubber is often planted on Malacca Series soil and seems to do reasonably well. Fruit trees such as rambutan could be tried. There are several areas of this soil which are at present under rubber and further development in this way is recommended.

Malacca-Kedah Association

The hilly area in the south has been largely mapped as an association. The Malacca Series appears to occupy the upper slopes of the hills and the Kedah Series the lower slopes and the areas of quartzite parent material.

The Kedah Series profile has a dark-brown-to-brown topsoil varying in depth between 2 and 4 in. The sandy loam texture is fairly uniform throughout except that it tends to a sandy clay loam at depths. Beneath the top horizon there is a 3 ft. horizon of yellow-brown-to-yellow coloured soil with a massive structure. Roots are numerous in the top 6 in. but there are few at the 3 ft. depth. The drainage is free down to 4 ft., at which depth some mottling occurs.

The Malacca and Kedah Series are quite suitable for rubber cultivation. The Association shown on the map covers an area of 5,000 acres.

Kampong Lubok Kiat Series

This is probably one of the poorest soils but it is fortunately of small extent, covering some 2,000 acres on the upper terrace in the middle of the area. It has been formed on uplifted Triassic sediments and has been subjected to weathering and leaching for a long period. Little has been added to the soil and it is in an advanced senile stage.

Profile

Slope A; hog-wallowed surface under dense cover which includes spindly tembusu, poor bamboo and resam (*Gleichenia linearis*); thick leaf litter on surface. Horizon boundaries were generally diffuse and sub-division was made at arbitrary intervals.

0 – 1 in.	Dark grey-brown (10YR 3/2) fine sandy loam with good medium crumb structure; very thickly rooted.
1 – 6 in.	Uniform grey (10YR 6/1) loamy sand with many roots and a fine crumb structure; drainage free.
6 –12 in.	Light grey (10YR 7/1) sandy loam with fewer roots than in the 1 to 6 in. depth; structure deteriorates with increasing depth; horizon boundaries diffuse.
12 –18 in.	As above, with very faint rust mottling at 15 in.; few roots and massive structure.
18 –24 in.	Light grey sandy loam which is very much compacted; massive structure, poor drainage and moist soil; very few roots.
24 –39 in.	Grey sandy clay matrix with many medium and coarse distinct yellow (10YR 8/8) mottles; firm consistency and weak coarse sub-angular blocky structure; few roots and imperfect drainage.
39 –54 in.	Grey clay matrix with many medium and coarse red (7.5R 5/6) mottles; a few yellow mottles are present and mottling covers over 50 per cent of the surface; structureless *in situ*; cracks out on drying; roots practically non-existent; clear boundary at 39 in.
54 –69 in.	As above with less mottling at 69 in. Below 69 in. the red mottling decreases.

A few lumps of lateritic type material were found in the profile and they became hard on drying. No concretions were found *in situ*. The profile is poorly drained and further development would tend to produce a typical laterite soil.

Fertility

Except in the top horizons, which are influenced by organic matter, the fertility is very low and it is not a promising soil for agriculture. Tree crops would be restricted in root-room by the compacted zone at 18 in.

Peat and Muck Soils

These soils occur mainly in the north-west of the area and occupy about 5,000 acres. The average depth of the peat is about 3 ft. and it seldom exceeds 6 ft. The area marked as peat on the soil map has a very uneven surface; the peat is formed in the lower parts and it often contains a high percentage of water. The vegetation is poor and the peat itself (presumably formed from similar poor vegetation) is acid and gives very low values for P and K, unlike most peats in other parts of Malaya which show high values for phosphorus and, especially, potassium.

The effect of clearing the jungle on the areas of shallower peat seems to be that the peat dries out, shrinks and oxidises and a much hog-wallowed surface results. A soil like the Kampong Cherang Hangus Series then develops.

KAMPONG CHERANG HANGUS SERIES

This series is widespread in the northern half of the area and occupies an area of 11,000 acres. Its parent material is poor alluvium. Patches within the series mapped are of a heavier clay loam to clay which is usually grey-to-white in colour. With the alterations in the beds of the streams this alluvium must have been deposited in strips and horizons of varying and intermixed texture. The survey was not carried out in sufficient detail to differentiate them and it is sufficient to group them together for the purpose of mapping and discussion as to land development.

Profile

Occurs in an open, hog-wallowed, uncultivated area of slope A; rumput jenaris and palas (*Licuala* sp.) form the main vegetation. The profile shows signs of what might be a buried organic layer, i.e. a former topsoil.

0 – 1 in.	Dark grey sandy clay loam with plentiful roots; fine crumb structure; slightly plastic when wet; free drainage.
1 – 5 in.	As above, with a little rust staining around the root channels.
5 –17 in.	Grey clay loam with a medium, sub-angular, blocky structure; roots plentiful; free drainage; small faint rust mottles, especially around root channels.
17 –28 in.	Presumably a buried topsoil consisting of a dark grey clay loam with a very good medium crumb structure; slightly moist and well rooted.
28 –33 in.	Grey clay with massive structure; few faint medium red-brown mottles; patches of organic staining; slightly moist and sticky.
33 –42 in.	As above, but lighter in colour; very distinct black and purple specks and splotches of bright purple which are presumably caused by manganese. The two bottom horizons are imperfectly drained and moist.

Fertility

The upper horizons show average figures for potassium and phosphorus while the lower horizons have very low values. The buried organic layer has a markedly higher phosphorus content, but loss on ignition and carbon analyses are not as high as might have been expected from the dark colour of the horizon. It obviously requires only a small content of humus in order to impart such a dark colour to the sandy soil.

This soil type is probably formed when the jungle or gelam is cut and burnt. The surface is very much hog-wallowed (i.e., channelled and hummocky) and for agricultural use it would have to be ploughed, levelled and drained. It is not a fertile soil.

PADANG GONG CHENAK SERIES

This series occurs on B slopes in gently undulating open country. It covers about 4,000 acres in the east and central parts of the area. It is found on the upper terrace but appears to be a younger soil than the Kampong Lubok Kiat Series.

Profile

On B slope; sparse rumput jenaris on surface; scattered clumps of bushes; abandoned padi fields common.

0 – 1 in. Very dark grey organic-stained sandy loam with plentiful roots; weak fine crumb structure and loose consistency.

1 – 8 in. As above, with few roots and lighter colour.

8 –21 in. Light grey sandy clay loam matrix with a few organic-stained patches; frequent medium and distinct orange mottles; massive structure and moist, slightly plastic soil.

21 –32 in. Brownish-yellow fine sandy clay with frequent medium and distinct red-brown mottles; imperfect drainage; sub-angular medium blocky structure; slightly sticky soil.

32 –44 in. Whitish-grey sandy clay matrix with red mottles frequent, large and prominent; poor drainage and slightly sticky soil; mottled patches are slightly hard and are probably in the process of forming concretions. Hard concretions were encountered on augering below 44 in.

This profile bears similarities to the Kampong Lubok Kiat Series but is not in such an advanced stage of development. Other parts of the same area (which have been mapped as one series) show variations from the profile examined. Colour is often more yellow-brown and mottling is less pronounced.

Fertility

The phosphorus and potassium figures and the low loss on ignition indicate a soil with a low nutrient supply. The organic layer does not show a markedly higher content of nutrients, as is generally the case, and it is likely that slow and gradual sheet erosion is taking place despite the grass cover.

The area in which the pit was dug is marked on the topographical map as a grazing reserve, but the grass is very poor and sparse. The old padi fields indicate attempts at cultivation but the farmers said that very poor padi grew and that other crops were poor. Any development of the area would necessitate the use of organic and/or mineral fertilisers—especially phosphate.

BUKIT TUKU SERIES

This soil is one of the poorest in the area and it occupies 13,000 acres, mainly on the upper terrace in the central part of the area. The vegetation associated with this series is poor, mixed secondary jungle growth with frequent clumps of bamboo.

Variations in the topsoil texture, from loamy sands to sandy loams, occur within the series but mapping detail was not sufficient to differentiate the various soil types.

Profile

Pit situated on flat ground at top of B slope; spindly secondary jungle growth and a few clumps of bamboo.

0 – 1 in.	Light brown fine sandy loam with many roots; fine weak crumb structure, easily crushed; free drainage.
1 – 6 in.	As above, with lighter colour.
6 –14 in.	Very pale brown fine sandy loam with few roots; fine weak crumb structure; few faint small orange mottles.
14 –21 in.	Whitish-grey sandy clay loam matrix with few distinct small orange mottles; no roots; moist soil, slightly sticky; weak crumb structure; imperfect drainage.
21 –32 in.	As above, with orange mottling common.
32 –38 in.	White sandy clay matrix with many prominent medium red-brown mottles; imperfect drainage.

Fertility

Save in the top 6 in., where there is a little organic matter, the phosphorus and potassium values are very low. The pH of the top two horizons is markedly acid and indicates heavy leaching from these horizons. Any nutrients come mainly from the organic matter.

There are a few scattered *kampong** houses on this type of soil. Secondary jungle growth and jungle have been cleared and burnt and pine-apples are the most commonly grown crop. They take a long time to mature, but they are of quite good quality and very sweet. Phosphate fertilisers give a great improvement in growth and should be used whenever possible. Agricultural practices aimed at preserving and increasing the organic matter of the topsoil are particularly necessary for such soils.

Kelantan Plain Series

This group includes the better padi soils of the area and covers about 4,000 acres, mainly in the north.

Profile

The pit was situated in a padi field which was stated to give a rather poor yield of about 100 *gantangs* per acre. A padi planter stated that if the water from the nearby gelam forest could be stopped from entering the area, then padi yields might be much better. The surface soil has inch-wide cracks but is quite wet and soft. The ground is poorly drained and the water table is high. There is practically no organic litter on the surface.

0 – 2 in.	Dark grey clay with weak granular structure; frequent prominent medium rust-red mottles; plentiful roots; slightly sticky, slightly plastic and non-coherent.

* *kampong* = village.

2 –14 in. Dark grey clay; blocky structure; frequent prominent coarse orange-yellow mottles along all root courses and crack faces; slightly plastic; slightly sticky.

14 –20 in. Light whitish-grey clay with prominent coarse mottles along cracks and root traces; non-plastic, non-sticky.

20 –33 in. Yellow-brown clay with much iron colouration, grey mottles along old root traces and frequent fine faint grey mottles in matrix; soil has a granular structure; non-sticky, non-plastic.

33 –42 in. Grey clay with frequent prominent coarse rust-red mottles; slightly sticky, slightly plastic.

No concretions appear in the profile, although the 20 to 33 in. horizon is one of deposition. The horizon below 33 in. is very well consolidated, but the 20 to 33 in. horizon is very friable.

Fertility

Analyses show average nutrient contents and a moderately good soil for padi cultivation. Better water control and the use of fertilisers are the obvious means of improving yields.

Laboratory Investigations

Mechanical analysis was done by the Bouyoucos Hydrometer Method; pH was measured using a glass electrode; carbon and nitrogen analyses were done by the Walkley-Black and micro-Kjeldahl methods, respectively; phosphorus was measured in an extract of hydrochloric acid and ammonium fluoride (pH 1.8) and potassium in a 0.5 N acetic acid extract. Analytical results are reported in Table I.

Two profiles (Table II) were examined for cation-exchange capacity and exchangeable cations by the method of Mehlich (4). The profile from the Kampong Cherang Hangus Series has a high exchange capacity in the top inch (presumably due to organic matter) and a low one in the other horizons. The percentage saturation is very low. The profile from the Kampong Lubok Kiat Series has a low exchange capacity and very low percentage saturation.

Similar determinations were made on the five topsoil samples taken for use in pot experiments and the results obtained are included in the relevant section of this article (Table VII).

Pot Experiments

Introduction

Do the soils of the Kelantan Deficiency Area justify the term "deficient" and, if so, in what are they deficient? The first part of the question is easily answered by even a cursory visual examination of the area; the soils are very poor and the vegetation sparse. But the second part of the question must be investigated further. It is almost certain that there are some major element deficiencies, and the possibility of minor element deficiencies has been mentiond.

It was decided to conduct a series of pot experiments to investigate and enumerate such deficiencies and so give a guide to future field experiments.

Soils Used

Bulk samples of topsoil (0 to 6 in. layer) were collected from five areas. Two of the soils were from the Kampong Pusu Series, one being taken from Kampong Pusu (Fields 4 and 8) and the other from Padang Siam. The other three were from the Bukit Tuku, Kampong Lubok Kiat and Kampong Cherang Hangus Series. The soils were brought to the laboratory in Kuala Lumpur, dried in the sun, ground to pass a 2 mm. sieve and thoroughly mixed.

Experimental Details

Webb (7) describes a new approach to the study of the fertility of tropical soils. In his paper he states, "While any fertilizer only becomes of real value where it is effective in the field, it does not follow that the field experiment is the best method for investigating fertilizer requirements in the first instance." The "subtractive" method he uses is virtually limited to pot work, in which it is easy to prepare small amounts of the required nutrient mixtures.

The method involves the use of a good "complete" nutrient solution, compounded from pure chemicals and containing all the 12 known essential mineral elements. Other solutions are prepared in which each essential element is withheld in turn from the "complete" nutrient mixture. These 12 "incomplete" nutrient solutions, pure water and "complete" nutrient solution are given, and the 14 treatments may be expected to give a good indication of the capabilities of the soil. "They should show .... whether or not it is possible to get better growth by mineral supplementation, and also which elements need and need not be supplied in extra quantities."

The normal "additive" method of experimentation naturally leads to a greater number and complexity of treatments, and there are certain difficulties in nutrient solution preparation. The "subtractive" method should give an excellent guide in the subsequent planning of field fertiliser trials.

TREATMENTS

In the pot experiments the treatments were:-

Water only	W
Minus potassium	–K
Minus calcium	–Ca
Minus phosphorus	–P
Minus nitrogen	–N
Minus magnesium	–Mg
Minus minor elements	–Min.El.
Complete nutrient solution	C
Farmyard manure	FYM
Water extract of FYM	Ex. of FYM
Mineral solution equivalent to FYM ..	M ≅ FYM

NUTRIENT SOLUTION

Glass-distilled water was used to make all the solutions. The complete nutrient solution formula was as follows:-

KCl	.. 5 g.	per 10 l. of solution ready for application.
$(NH_4)_2SO_4$	.. 5 ,,	
$NaH_2PO_4.2H_2O$	.. 7.7 ,,	
$MgSO_4.7H_2O$	.. 8.92 ,,	

In addition, 1 ml. of trace element stock solution was added. This solution had the following composition:-

$MnSO_4.4H_2O$	.. 4.46 g.	per 200 ml. of solution.
$CuSO_4.5H_2O$	.. 0.50 ,,	
$ZnSO_4.7H_2O$	.. 0.58 ,,	
H_3BO_3	.. 3.72 ,,	
$(NH_4)_6Mo_7O_{24}.4H_2O$	.. 0.07 ,,	

The calcium was added separately in aliquots from a suspension containing 36.96 g. of CaO per 10 l. of distilled water.

The addition of 500 ml. of nutrient solution to the 1,500 g. of soil in each pot gave fertiliser additions equivalent to the following:-

K ..	3 cwt. of muriate of potash per acre
N ..	3 cwt. of ammonium sulphate per acre
P ..	6 cwt. of Christmas Island rock phosphate per acre
Ca ..	2 tons of calcium carbonate per acre
Mg ..	3 cwt. of magnesium sulphate per acre.

The effect of farmyard manure was examined separately by the following treatments:-

(i) Farmyard manure .. 30 g. per pot ≅ 20 tons per acre.

(ii) A water extract was prepared by shaking 5 kg. of farmyard manure with 5 l. of distilled water. 500 ml. of this solution was added to the pots treated. This treatment was made in order to try to distinguish between the physical and any microbiological effect of the manure.

(iii) A total analysis of the farmyard manure was made and a solution containing equivalent concentrations of the minerals present was prepared. Trace elements were added to this solution.

PROCEDURE

Earthenware pots (6½ in. diameter and 6 in. high), with a single drainage hole in the bottom, were painted with three coats of pure bituminous paint. A layer of acid-washed gravel and a little sand were placed in the bottom and 1,500 g. of soil were added to each pot. In all, there were five different soils and 11 treatments in duplicate, giving 110 pots in the experiment.

The water-holding capacity of the dry soil was determined and half this volume of water was added to the dry soil. Each pot was then weighed in this state.

Tomato seeds (variety Ponderosa) were planted in sand in seed boxes. When the seedlings were about 3 to 4 in. tall they were transplanted, two to each pot. There was a little trouble with dying-off of seedlings, particularly in pots which received the water, the minus-phosphorus, the minus-calcium, the minerals-equivalent-to-farm-yard-manure and the extract-of-farm-manure treatments. New seedlings were planted, but in many cases they still did not "take" well and, because of this, treatment differences may be rather exaggerated.

Water was added to each pot to keep the moisture at or just above 50 per cent of the water-holding capacity. This required about 200 ml. per week in the initial stages and about 500 ml. per week in the later stages of growth.

Calcium was added in aliquots of 20 ml. of suspension until the full treatment had been given. It was later realised that this was not a good method of addition (although it may well be very similar to field application), because only the top 2 in. of soil in the pot was affected. Subsequent pH measurements showed values around 7 at the top and 4.5 at the bottom of the pot. It might have been better either to add the calcium as a bicarbonate solution or to mix in all the required carbonate initially.

Nutrient solutions were added in weekly aliquots of 50 ml. until the necessary ten aliquots had been given. Periodically, notes were made on the growth and the appearance of any symptoms (Table III). The plants were harvested after 12 weeks of growth. The leaves, stems and roots were oven-dried and their weights recorded (Table IV). The leaves and stems of the plants from two of the soil series were then ashed and the ash was analysed for N, P, K, Ca and Mg (Table V). A summary of the general results is given below under the heading of each soil used.

Conclusions

SOILS

Kampong Pusu Series Soil from Kampong Pusu

Growth was generally best in this soil. Except in the W and –P treatments, plants made even growth and had a healthy dark green colour for the first 12 weeks, but after that the plants did begin to show some symptoms of the various element deficiencies. The FYM treatment produced the best early growth, but at a later stage nitrogen and minor element deficiency symptoms appeared.

Kampong Lubok Kiat Series

This is one of the poorest soils of the area and supports a very poor vegetation. Despite its apparent senility, the plants grew moderately well in the soil taken from the upper 6 in. of the profile, presumably because of the organic matter content. Growth was very poor in the W, –P, –Ca, M ≅ FYM and Ex. of FYM treatments. The plants reached average height in the –K, –Mg, –N, –Min.El. and FYM treatments, though deficiency symptoms appeared in all of them. Potassium deficiency symptoms were not clearly marked. The symptoms which appeared in the –Min.El. and FYM treatments were similar to those obtained in molybdenum deficient plants (6) and this minor element deficiency (and perhaps others) was suspected. Plants grown in the complete nutrient solution were very healthy, save for a little green mottling which might have been due, in part, to fungus infection.

Kampong Pusu Series Soil from Padang Siam

Although the soil in this area has been mapped as Kampong Pusu Series, it showed some variations in the pot tests. This was probably caused by the differences in the organic matter content of the top 6 in. Growth was poor in the W, –P, –Ca, M ≅ FYM, and Ex. of FYM treatments and deficiency symptoms were apparent in all the others except the complete nutrient solution treatment.

Bukit Tuku Series

This is one of the very poor soils in the area and it is generally very sandy. The topsoil taken for the pot experiments was less sandy, however, and contained a little organic matter. Growth of plants was similar to but better than that in the Padang Siam soil.

Kampong Cherang Hangus Series

Growth was poorest in this soil. The average height of the plants was less than in any other series and deficiency symptoms were similar to those in the other series.

TREATMENTS

Phosphorus is the most obviously deficient element in all the soils. Magnesium deficiency shows up clearly in all but the Kampong Pusu soil, in which symptoms are less well defined. Calcium deficiency would appear to be marked in the Bukit Tuku, Padang Siam and Kampong Cherang Hangus soils but plants did not seem to "take" well in these pots and the differences may be rather enhanced. It was noticed, however, that in all pots without calcium (e.g. in the "water only" treatments) there was a noticeable green algal growth.

Minor element deficiency was fairly well marked and symptoms most closely resembled those of molybdenum deficiency. A solution containing 100 p.p.m. molybdenum was painted on a few affected leaves and some recovery was observed in that the leaves partly regained their healthy green colour.

Potassium and nitrogen deficiencies were not pronounced and, in field experiments, it might be sufficient to give a basal dressing of these elements.

The complete nutrient solution gave good but not as vigorous growth as the FYM treatment. The attempts to differentiate the effect of FYM by the treatments M ≡ FYM and Ex. of FYM were not really successful. However, it can be said that the excellent effect of FYM is not due to its mineral content alone. It may be due to the combined effects of the organic matter and minerals, the former having a noticeable effect on the tilth of the topsoil in the pots. It would have been interesting to try the effect of adding chopped straw or some similar, relatively inert mulch.

The appearance of what was taken to be a deficiency of minor elements in the FYM treatment was surprising. Leaf painting with a 100 p.p.m. molybdenum solution did not bring about any definite improvement in the leaf colour and time did not allow a check experiment in which FYM could be compared to FYM plus minor elements.

The FYM came from the abattoirs in Kuala Lumpur and its total analysis, as well as that for English farmyard manure, was as follows:-

	Malayan Farmyard Manure (per cent)	English Farmyard Manure (Average Values) (per cent)
Moisture	60.7	75
On the dry sample:		
Loss on ignition	62.9	72
Nitrogen	1.7	2.3
P_2O_5	1.5	1.0
K_2O	1.5	2.4
CaO	1.9	—
MgO	1.2	—

These figures compared favourably with the average for English FYM, but it is possible that Malayan FYM is somewhat deficient in minor elements. Pasture in Malaya is generally poor and might well contain only the bare minimum of such elements as boron, molybdenum, and copper, etc., and the resulting manure could be deficient in these.

The very poor growth with the M ≡ FYM treatment is difficult to explain. The N, P, K, Ca and Mg contents of the M ≡ FYM were similar to those in the complete nutrient solution treatment and there seems to be no reason to explain why the plants did not grow equally well.

The results obtained from this form of "subtractive" experiment are of much interest. It is quite a simple experiment to conduct and it is of great value as a preliminary investigation before the field experiment stage.

The bulk soil samples were taken from the 0 to 6 in. depth, the horizon richest in organic matter. The organic matter, with its beneficial effect on nutrient supply, and/or on structure, has probably lessened the differences between the various soil series. However, it is this part of the soil

profile which is of most interest from the point of view of plant growth, and the other profile characteristics (such as root-room and drainage) which affect plant development have been noted by visual examination and soil analysis.

Soil and Plant Analysis

Plant Analysis

The ash, nitrogen and calcium contents in the FYM treatments are much lower than the average; the phosphorus, potassium and magnesium contents in the FYM treatments are higher than average. The complete treatments gave analysis figures which are very close to average. Analyses are given in Table V.

Other results agree well with what might be generally expected, i.e. minus potassium gives low potassium in the plant and it results in an increased uptake of calcium and magnesium. The minus magnesium treatment gave clear deficiency symptoms in the Bukit Tuku Series but not in the Kampong Pusu Series and the plant analyses show corresponding differences.

Soil Analysis

Analyses were done on the five soils used in the pot experiments, before and after the treatment with complete nutrient solution (Table VI). The layer of sand placed at the bottom of the pot has in some cases become incorporated with the soil and, if this is taken into account, the mechanical analysis figures show quite close agreements. Carbon, nitrogen and potassium contents have been reduced and phosphorus has increased.

It is interesting to note that the phosphorus increase is highest in the soil containing least clay and there would appear to be a fairly close correlation between P fixation and clay content. The Bukit Tuku Series soil had the highest contents of available and exchangeable potassium and also shows the highest drop in these contents after completion of the pot experiments.

The cation exchange capacity figures show a general fall in the contents of potassium and sodium (the monovalent cations) and a rise in the contents of calcium and magnesium (the divalent cations). The figures are shown in Table VII.

SOIL SCIENCE DIVISION
DEPT. OF AGRICULTURE, FEDERATION OF MALAYA.

SOIL MAP OF THE KELANTAN DEFICIENCY AREA

102° 00′ 102° 02′ 102° 04′ 102° 06′ 102° 08′

6° 02′ 6° 00′ 5° 58′ 5° 56′ 5° 54′ 5° 52′ 5° 50′

N

TO RANTAU PANJANG

REPEK

TO PASIR MAS

TO PASIR MAS

S. LEMAL

KG. PUSU

KAMPONG CHERANG HANGUS

S. TASIK GHARU

KG. BUKIT TUKU

S. JEGOH

P.D.G. GONG CHENAK

KG. LUBOK KIAT

PADANG SIAM

S. MARU

TOK UBAN

TO TANAH MERAH

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

307 308 309 310 311 306 305 304 303 302 301 300 299 298

BASED UPON SURVEY DEPARTMENT MAPS. PUBLISHED BY PERMISSION OF THE SURVEYOR GENERAL, MALAYA. GOVERNMENT COPYRIGHT RESERVED.

TRACE NET PLAN

Scale 5 miles to 1 inch
0 1 2 3 4 5

SOIL SERIES

- KAMPONG PUSU
- KAMPONG CHERANG HANGUS
- KAMPONG LUBOK KIAT
- BUKIT TUKU
- MALACCA
- LATI
- KELANTAN PLAIN
- PEAT AND MUCK SOILS
- MALACCA KEDAH ASSOCIATION
- P. D. G. GONG CHENAK
- UNSURVEYED

Scale 1 Inch To a Mile

MILE 1 0 1 2 MILES

Potentialities of the Area

Triassic rocks and sediments are the main soil parent materials and low fertility alluvial-colluvial soils have developed. About 43,000 acres, or 70 per cent of the total area, is occupied by poor soils and the remainder by soils of the Malacca, Lati and Kelantan Plain Series and the Malacca-Kedah Association, which are the most promising for development.

The potentialities of the area for padi have been considered from time to time. The Drainage and Irrigation Department has surveyed the northern part of the area, but it is considered that any large scale irrigation and drainage scheme would be impracticable because of the general uneveness of the terrain.

If padi is to be grown, then dry padi seems to be the obvious choice. The Department of Agriculture, Kelantan, has shown this to be possible and, with either mineral fertilisers or farmyard manure, it should be possible to obtain economic yields.

Rubber is grown on the Malacca and Lati Series soils, but much of the present rubber is old and badly kept and should be replanted. It would be most beneficial to apply a complete fertiliser mixture of rock phosphate, ammonium sulphate and magnesium limestone to the young rubber. Rubber could be further developed on soils of the Malacca-Kedah Association and it could be grown also on the upper terrace soils, but fertilisers would be essential.

Apart from the badly drained, low-lying areas, there are poorly drained localities on the upper terrace and this factor would need to be borne in mind.

It would be possible to grow fruit trees, e.g. rambutan, on many of the soils and especially on the soils on which rubber grows and could be grown. Citrus trees are another possibility, but marketing might present difficulties.

Pineapple growing is common on the sandy soils of the upper terrace and though, without manuring, they take a long time to reach maturity, the resulting fruits are of excellent flavour. Much more attention could be paid to this crop. The Department of Agriculture, Kelantan, has recently conducted experiments using fertiliser solution sprays on pineapples and excellent results have been obtained even with very dilute nutrient solutions.

The pot experiments clearly demonstrated deficiencies of phosphorus, calcium, magnesium and minor elements on most of the soils and if development of a large part of the area is to be envisaged, then a policy and system for applying fertilisers must be worked out. The use of mineral fertilisers or green manures and composts or farmyard manure, alone or in combination, would be necessary. Agricultural practices should aim at conserving and increasing the organic matter status of the soils.

From the soil map, a general indication can be given of the various areas which should be developed, and the diagram which follows shows the main divisions of the area and their development potentialities.

Table I

Soil Analyses

Sample No.	Depth (in.)	Percentages					Moisture (air/oven dry) (per cent)	pH	Percentages			C/N	Available	
		Clay	Silt	Fine Sand	Coarse Sand	Gravel			Loss on Ign.	C	N		P (p.p.m.)	K (p.p.m.)
Kampong Pusu Series														
RC743T	0– 1	29	25	45	1	Nil	3	4.8	11	3.00	0.20	15.0	11	49
Sa	1– 5	35	22	42	1	„	2	4.9	8	1.95	0.14	13.9	2	4
Sb	5–12	40	17	40	3	„	1	4.9	5	0.59	0.07	8.4	6	8
Sc	12–23	32	16	46	6	„	1	5.2	4	0.38	0.05	7.6	3	6
Sd	23–35	45	15	36	4	„	3	5.6	8	—	—	—	3	6
Se	35–48	54	16	28	2	„	3	5.2	8	—	—	—	2	6
Kampong Cherang Hangus Series														
RC606T	0– 1	25	23	46	6	Nil	4	4.7	23	7.86	0.55	14.3	19.5	90
Sa	1– 5	8	15	63	14	„	3	4.9	13	3.55	0.31	11.5	12	20
Sb	5–17	41	16	29	14	„	2	5.0	7	0.51	0.08	6.4	10	6
Sc	17–28	41	22	32	5	„	2	4.8	6	0.59	0.07	8.4	25	4
Sd	28–33	51	12	28	9	„	2	4.8	6	—	—	—	8	4
Se	33–42	52	10	27	11	„	3	4.7	6	—	—	—	8	4

Lati Series														
RC604T	0– 1	22	19	17	42	Nil	2	4.8	7	2.58	0.20	12.9	8	51
Sa	1– 3	27	16	17	40	„	2	4.7	6	1.35	0.14	9.6	8	22
Sb	3–14	34	10	11	45	„	1	5.0	5	0.51	0.04	12.8	1	4
Sc	14–30	30	14	14	42	„	1	4.9	5	0.59	0.11	5.4	3	8
Sd	30–48	24	6	15	55	„	1	5.1	3	—	—	—	7	6
Kelantan Plain Association														
RC599T	0– 1	49	33	17	1	Nil	7	4.0	14	3.38	0.32	10.6	29	44
Sa	1– 2	47	30	22	1	„	7	4.0	15	3.46	0.30	11.5	36	40
Sb	2–14	60	24	16	Trace	„	10	4.2	15	3.67	0.32	11.5	74	15
Sc	14–20	68	22	10	„	„	4	4.7	9	0.68	0.07	9.7	10	15
Sd	20–33	56	29	15	„	„	4	5.0	8	—	—	—	5	15
Se	33–42	47	23	20	10	„	3	4.9	6	—	—	—	6	15
Peat and Muck Association														
RC761		P E A T					10	3.5	72	38.4	1.02	37.6	10	17

(cont.)

Table I (cont.)

Soil Analyses

Sample No.	Depth (in.)	Percentages					Moisture (air/oven dry) (per cent)	pH	Percentages			C/N	Available	
		Clay	Silt	Fine Sand	Coarse Sand	Gravel			Loss on Ign.	C	N		P (p.p.m.)	K (p.p.m.)
Bukit Tuku Series														
RC747T	0– 1	10	20	67	3	Nil	1	3.9	6	1.90	0.15	12.7	15	30
Sa	1– 6	14	18	66	2	„	1	3.9	5	1.10	0.10	11.0	8	20
Sb	6–14	16	12	69	3	„	1	4.4	3	0.47	0.06	7.8	6	8
Sc	14–21	22	11	65	2	„	2	4.8	3	0.38	0.05	7.6	4	8
Sd	21–32	34	14	51	1	„	1	4.9	5	—	—	—	1	8
Se	32–38	49	10	40	1	„	2	4.8	8	—	—	—	1	8
Malacca Series														
RC742T	0– 1	18	17	49	16	„	2	4.3	10	2.24	0.14	16.0	13	68
Sa	1– 6	22	15	47	16	„	2	4.9	8	1.57	0.11	14.3	7	22
Sb	6–16	28	3	56	13	„	2	4.9	7	0.77	0.07	11.0	2	6
Sc	16–27	32	12	43	13	„	1	5.5	6	0.59	0.06	9.8	3	8
Sd	27–36	35	12	42	11	70	2	5.1	7	—	—	—	1	2

Padang Gong Chenak Series														
RC760T	0– 1	14	19	54	13	Nil	2	5.3	6	1.92	0.15	13.2	10	32
Sa	1– 8	16	18	50	16	„	1	4.2	4	1.02	0.12	8.5	8	17
Sb	8–21	29	12	48	11	„	3	4.7	4	0.54	0.07	7.3	7	17
Sc	21–32	41	10	42	7	„	2	4.9	6	0.48	0.05	10.4	6	17
Sd	32–44	47	8	39	6	„	2	5.1	7	—	—	—	6	6
Kampong Lubok Kiat Series														
RC741T	0– 1	10	43	39	8	Nil	2	4.8	7	2.75	0.16	17.2	16	58
Sa	1– 6	12	16	57	15	„	2	4.7	4	1.82	0.12	15.2	11	22
Sb	6–12	16	14	57	13	„	1	4.9	4	1.14	0.11	10.4	12	22
Sc	12–18	16	20	51	13	„	1	4.8	2	0.93	0.06	15.5	7	8
Sd	18–24	18	16	54	12	„	1	4.9	2	—	—	—	3	8
Se	24–39	43	8	43	6	„	2	5.0	5	—	—	—	1	15
Sf	39–54	49	19	32	Nil	„	3	5.1	5	—	—	—	1	30
Sg	54–69	49	16	35	„	„	2	4.9	5	—	—	—	1	20

Table II

Caton Exchange Determinations

Soil No.	C.E.C. (m. eq./100g.)	Total Cations	Potassium	Calcium	Sodium	Magnesium	Total K+Ca+Na+Mg	Hydrogen	Percentage Saturation
Kampong Lubok Kiat Series									
RC740T	15.60	15.28	0.31	0.21	0.20	0.56	1.28	14.00	9.2
Sa	13.50	12.07	0.27	0.16	0.19	0.25	0.87	11.20	6.4
Sb	15.60	11.39	0.21	0.15	0.14	0.29	0.79	10.60	5.1
Sc	17.65	15.88	0.18	0.17	0.15	0.18	0.68	15.20	3.9
Sd	21.40	19.17	0.19	0.17	0.19	0.22	0.77	18.40	3.6
Se	20.40	18.14	0.26	0.18	0.31	0.23	0.98	17.16	4.8
Sf	19.20	17.51	0.18	0.18	0.16	0.19	0.71	16.80	3.7
Sg	18.50	13.86	0.27	0.21	0.22	0.16	0.86	13.00	4.7
Kampong Cherang Hangus Series									
RC606T	35.35	35.84	0.35	0.22	0.37	0.50	1.44	34.40	4.1
Sa	20.70	20.39	0.21	0.24	0.20	0.14	0.79	19.60	3.8
Sb	13.25	11.45	0.14	0.14	0.14	0.23	0.65	10.80	4.9
Sc	16.50	14.31	0.14	0.19	0.16	0.14	0.63	13.68	3.8
Sd	10.20	8.86	0.20	0.16	0.17	0.13	0.66	8.20	5.9
Se	10.65	9.46	0.15	0.16	0.14	0.21	0.66	8.80	5.5

Table III

Appearance of Plants at Harvesting Time

atment	(1) Kampong Pusu Series Soil from Kg. Pusu	(2) Kampong Lubok Kiat Series	(3) Kampong Pusu Series Soil from Padang Siam	(4) Bukit Tuku Series	(5) Kampong Cherang Hangus Series
Water	Av. height 3 in. Purple stems and veins; old leaves yellow; young leaves dark green.	Av. height 1¾ in. Symptoms similar to those in (1).	Av. height 1½ in. Symptoms as in (1).	Av. height 1¾ in. Symptoms as in (1). Some of the old leaves have purple tips.	Av. height 2 in. Symptoms as in (1).
-P	Av. height 2¾ in. Young leaves dark green; old leaves yellowing from tips; purple veins and stems.	Av. height 2 in. Symptoms as in (1).	Av. height 2 in. Symptoms as in (1). A few leaves have a marked grey tinge.	Av. height 2¾ in. Symptoms as in (1).	Av. height 3½ in. Symptoms as in (1).
-K	Av. height 13 in. Young leaves healthy; a little light green mottling on older leaves.	Av. height 13 in. Old leaves yellow; light purple veins; some interveinal mottling.	Av. height 10 in. Interveinal mottling (light green) on most leaves.	Av. height 14 in. Symptoms as in (2). Some leaves have scorched tips and margins.	Av. height 8 in. Symptoms as in (2).
-Mg	Av. height 13 in. Old leaves yellow; a little mottling on edges and interveinally.	Av. height 12 in. Marked interveinal chlorosis, brown scorched patches or lesions; branches curve downwards.	Av. height 12 in. Symptoms as in (2).	Av. height 15 in. Symptoms as in (2) .	Av. height 10 in. Symptoms as in (2).
-N	Av. height 13½ in. Old leaves pale green; some interveinal - to - marginal mottling.	Av. height 15 in. Old leaves pale green with light purple veins; marginal mottling; purple and burnt spots on margins.	Av. height 12½ in. Symptoms as in (1).	Av. height 14½ in. Symptoms as in (2).	Av. height 11½ in. Old leaves pale yellow with burnt tips; some interveinal and marginal mottling.
-Ca	Av. height 11 in. Healthy, apart from some marginal mottling.	Av. height 2 in. Very poor growth.	Av. height 6 in. Some mottling on old leaves.	Av. height 11 in. Old leaves pale green with a little marginal mottling.	Av. height 7½ in. Lower part of stem purple; old leaves yellow; some marginal mottling on older leaves.
Minor ements	Av. height 12½ in. Older leaves slightly yellow with interveinal and marginal mottling; purple veins and patches on yellow leaves; leaves curl upwards.	Av. height 11 in. Symptons as in (1) but symptoms more severe. Old leaves have burnt tips.	Av. height 12 in. Symptoms as in (2). Veins markedly purple.	Av. height 10 in. Symptoms as in (2).	Av. height 9 in. Marked inward rolling of leaves; marginal mottling; old leaves have purple veins.
mplete	Av. height 13 in. Healthy growth; slight marginal mottling on older leaves.	Av. height 14 in. Old leaves pale green with some interveinal and marginal mottling. Healthy growth.	Av. height 14 in. Symptoms as in (2). Some old leaves are yellowed.	Av. height 14 in. Symptoms as in (2).	Av. height 12 in. Symptoms as in (2).
YM	Av. height 16 in. Interveinal and marginal mottling; leaves curling up; purple veins and patches on old leaves.	Av. height 16 in. Symptoms as in (1) with old leaves very yellowed.	Av. height 14½ in. Symptoms as in (2).	Av. height 16½ in. Symptoms as in (2).	Av. height 14 in. Symptoms as in (2). Two old leaves have black surfaces and are dark purple underneath.
Minerals q valent FYM	Av. height 11 in. Some light green mottling apparent.	Plants died.	Plants died.	Av. height 2 in. Stunted growth.	Av. height 5 in. Marginal light green mottling.
Extract FYM	Av. height 6 in. Twisted leaves and marginal mottling.	Av. height 1½ in. Purple veins on the old leaves which are yellowed.	Av. height 1½ in. Very poor growth. Purple veins on the leaves.	Av. height 2½ in. Very poor growth. Symptoms as in (3).	Av. height 1½ in. Symptoms as in (3).

Table IV

Oven-Dry Weights of Plants plus Roots
(Average for two pots)
(grammes)

Soil	W	–K	–N	–Mg	–P	–Ca	–Mi.El.	Complete	FYM	Total
Kampong Pusu	0.13	3.15	3.62	3.99	0.13	3.21	4.05	4.00	6.10	28.38
Kampong Lubok Kiat	0.04	3.58	3.21	3.31	0.07	—	2.24	4.13	5.01	21.59
Padang Siam	0.04	2.14	2.05	2.09	0.12	2.09	3.83	3.68	4.50	20.54
Bukit Tuku	0.05	4.40	4.10	4.54	0.41	2.06	2.86	4.76	5.71	28.89
Kampong Cherang Hangus	0.05	2.00	2.81	2.08	0.37	1.67	2.07	3.32	4.47	18.84
Total	0.31	15.27	15.79	16.01	1.10	9.03	15.05	19.89	25.79	118.24

Table V

Plant Analyses

Treatment	Bukit Tuku Series						Kampong Pusu Series					
	Per Cent Dry Matter		Per Cent Ash				Per Cent Dry Matter		Per Cent Ash			
	N	Ash	P	K	Ca	Mg	N	Ash	P	K	Ca	Mg
Complete	1.7	13.0	1.5	27.3	13.0	2.6	2.4	14.6	1.2	20.0	16.6	5.0
–K	2.3	11.7	1.8	18.2	15.9	3.5	2.8	11.9	1.5	8.7	20.2	6.3
–Ca	3.2	12.0	1.7	33.3	3.9	3.4	3.4	13.7	1.5	24.3	9.8	6.9
–Mg	1.8	14.8	1.3	27.1	13.2	1.7	2.2	13.3	1.2	20.6	17.5	3.9
–N	1.8	13.8	1.5	27.8	12.9	2.7	2.0	14.5	1.1	20.3	16.0	4.4
–Mi.El.	2.6	18.6	1.1	24.9	11.6	2.2	2.6	14.7	1.3	19.3	17.1	4.4
FYM	1.5	10.3	1.9	33.8	7.4	3.9	1.4	10.3	1.9	25.9	11.2	5.9
Average	2.1	13.5	1.5	27.5	11.1	2.9	2.4	13.3	1.4	19.9	15.5	5.3

Table VI

Pot Soil Analyses

Soil Series	Percentages					Per Cent Moisture	Percentages			C/N	Available	
	Clay	Silt	Fine sand	Coarse sand	Gravel	Air/oven dry	Loss on ign.	C	N		P (p.p.m.)	K (p.p.m.)
Kampong Pusu Soil												
Original	31	21	42	6	Nil	4	11	2.52	0.21	11.9	13	34
After complete treatment	31	21	38	10	„	4	11	2.11	0.19	11.3	21	26
Kampong Lubok Kiat												
Original	12	20	52	16	„	1	4	1.23	0.11	11.2	4	30
After complete treatment	17	14	41	28	„	3	4	0.84	0.08	10.5	38	25
Padang Siam												
Original	37	21	40	2	„	3	8	1.42	0.16	8.9	6	20
After complete treatment	33	21	39	7	„	6	8	1.13	0.10	11.3	11	19
Bukit Tuku												
Original	18	21	34	27	„	2	5	1.14	0.11	10.4	9	80
After complete treatment	19	16	42	23	„	3	5	1.16	0.09	12.9	24	33
Kampong Cherang Hangus												
Original	42	20	34	4	„	4	12	3.22	0.29	10.2	21	40
After complete treatment	34	24	33	9	„	11	12	2.72	0.27	10.1	22	28

Table VII

Pot Soil Analyses

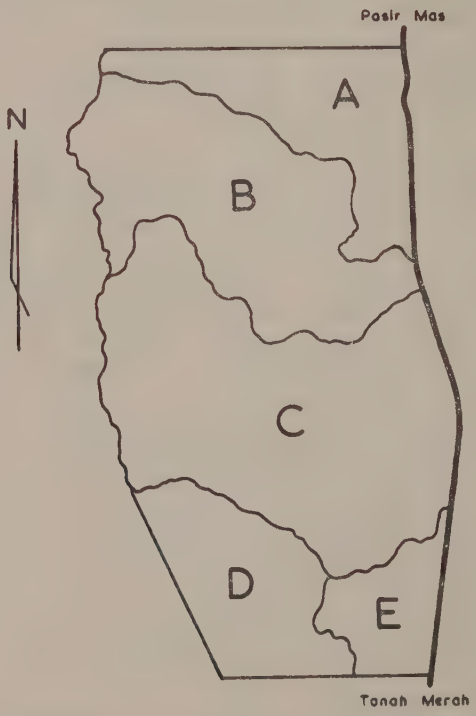
Cation Exchange Capacity

Soil Series	C.E.C. (m.eq./ 100g.)	Total Cations	Potas-sium	Calcium	Sodium	Magne-sium	Total K+Ca+ Na+Mg	Hydro-gen	Remarks
Kampong Pusu	19.73	22.29	0.05	0.35	0.06	0.19	0.65	21.64	Before start of pot expt.
-do-	18.91	20.27	0.05	1.27	0.09	0.38	1.79	18.48	At end of expt. Pots with complete treatment.
Kampong Lubok Kiat	9.18	10.32	0.10	0.24	0.08	0.10	0.52	9.80	Before start of pot expt.
-do-	8.08	7.61	0.05	1.48	0.12	0.48	2.13	5.48	At end of expt. Pots with complete treatment.
Padang Siam Soil	10.41	12.85	0.10	0.35	0.14	0.10	0.69	12.16	Before start of pot expt.
-do-	10.41	10.71	0.05	1.54	0.09	0.43	2.11	8.60	At end of expt. Pots with complete treatment.
Bukit Tuku	9.04	10.31	0.36	0.14	0.12	0.29	0.91	9.40	Before start of pot expt.
-do-	8.77	8.85	0.05	1.27	0.07	0.38	1.77	7.08	At end of expt. Pots with complete treatment.
Kampong Cherang Hangus	22.47	23.43	0.10	0.24	0.26	0.19	0.79	22.64	Before start of pot expt.
-do-	21.10	22.17	0.05	1.70	0.06	0.48	2.29	19.88	At end of expt. Pots with complete treatment.
Fertiliser addition to pots in m. eq. per 100 g. of soil	—	—	0.22	4.40	0.16	0.24	—	—	

Summary

A soil survey of the Kelantan Deficiency Area has been completed. About 60,000 acres were surveyed and eight soil series and two soil associations have been mapped. Five of the series have been classed as "deficiency" types and they occupy an area of 38,000 acres. The peat and muck association covers 5,000 acres.

A series of "subtractive" type pot experiments was carried out with five bulk soil samples from the area, using tomato as an indicator plant. Deficiencies of phosphorus, magnesium, calcium and minor elements (perhaps molybdenum and/or boron) showed up very clearly. Treatment with farmyard manure gave very good initial growth, but minor element deficiency appeared in the later stages.



A — Potential padi land.

B — Poor low-lying area of little immediate value.

C — Upper deficiency terrace with poor soils. *With use of fertilisers* could be developed for rubber, fruit trees, pineapples, etc.

D — Hilly area which could be used for rubber and/or fruit trees. This area could be developed first of all.

E — Undulating and flat ground of little use without fertilisers and drainage.

Initial development in the area should be confined to the hilly area in the south-west where smallholdings of rubber and/or fruit trees could be started.

A soil map is included in the report.

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SUNGEI MANIK PADI FARM SURVEY

Composition and Land Tenure, 1956

BY

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Introduction

A survey was requested in January, 1955, by Mr. H. J. Simpson, then State Agricultural Officer, Perak, to provide a rapid estimate for the 1955 Rice Committee of the distress among padi farmers caused by the Government's rice price policy (a reduction of the guaranteed minimum price for padi was announced only a short time before harvest).

The field work was carried out in three weeks of February and March as an additional part-time duty by local staff of the Departments of Agriculture and of Drainage and Irrigation under the charge of the Agricultural Officer, Perak South. The survey was so handicapped by the lack of sufficient time (for initial training, for supervision and checking during the survey, and for repeated "calls back" on doubtful issues afterwards) that it failed to fulfil its original purpose.

The survey did, however, provide some information of considerable value about certain economic features of padi farm organisation. This report is therefore presented as a description of the Sungei Manik padi farms—the number of farmers, the size and fragmentation of their farms, and the types and levels of rentals paid.

The organisation of the Sungei Manik padi farms over 20 years is indicative of the processes already completed in the older fully-settled and self-established areas of north Malaya. Many economic features of these areas, particularly land tenure, are becoming established very quickly in the new padi schemes organised by the Government.

The Survey

The survey consisted of the completion of questionnaires, by the Departments' interviewers, for those farmers who were cultivating certain sampled padi holdings. The sample consisted of a systematic selection with a fixed sampling fraction of one-twentieth of the alienated surveyed lots listed in the Section Records of the Department of Drainage and Irrigation. A total of 202 padi holdings was selected, of which five were not recorded and some others were recorded incompletely.

The History of Sungei Manik

The Sungei Manik area contains 18,600 acres of padi, on the coastal and riverine alluvial soils of Lower Perak, which were developed from jungle as a Government Scheme in four stages, starting in 1932 and continued until final colonisation *circa* 1953. About 500 acres of padi had previously been cultivated, since 1922, along the banks of an exploratory drain which extended two miles in the jungle and discharged into the Sungei* Manik. There was

* Sungei = River.

frequent and considerable flooding of the jungle, owing to river silting consequent upon earlier agricultural methods of establishing rubber land.

Initial irrigation works were commenced in 1932 with river headworks and an irrigation canal branch on both sides of the original drain to supply the 5,000 acres of Stage I. To assist settlers, distributary channels were constructed to bring irrigation direct to each settler's holding, and it was "not until water was seen to be flowing in these distributaries that the area became popular" (1). Protective bunds and river dredging ended the periodic flooding of the adjacent railway line and lowered the superficial water level in the jungle by 4 ft.

Settlement quickly followed. By December, 1936, when 8,000 acres were served by irrigation works in Stages I and II, some 6,500 acres of land had been alienated and almost three-quarters of this land (4,633 acres) was planted with padi. Various difficulties were encountered. Elephants caused damage to the Sungei Lampam bund in 1936. In the same year, higher prices for rubber and copra resulted in a decline in the acreage of padi planted in Stages I and II, much of which was alienated to Malays from Borneo and Java who had settled in the Lower Perak District many years previously and had established rubber and coconut small-holdings. Whilst Government wages for day labourers were raised from 50 to 60 cents per day, rubber tappers in the Perak riverine kampong* areas were earning 70 to 80 cents for a morning's tapping. Non-residents found it difficult to make a livelihood in the area and would spend a short time clearing a little jungle, cultivate some padi and then depart. Land in Stage II was found to have a slope with a gradient of 6 ft. per mile, so that one acre in twelve in this stage was too high to irrigate; and over the rest of the area it was necessary for each cultivator to undertake levelling and construction of small bunds before a gazetted time limit (50 farmers were prosecuted and 35 fined for slackness). A campaign to exterminate rats was necessitated by the heavy damage to the padi crop in 1937-38 season from rats living in the fallen jungle-timber.

"In the first few years, the work of felling and clearing a six-acre lot is a very arduous task for the colonist and it has been estimated to represent 4 years' solid work for a single settler without help" (2). In several instances a group of settlers from the same area worked communally under a headman. Dry padi and maize were sometimes planted as temporary crops before wet padi.

Increasing encouragement to permanent settlement was provided by the growing numbers of padi-field fish from the stock first introduced from Krian District in 1934. These were caught both for home consumption and for the sale of certain varieties to Chinese buyers for marketing in the towns of Telok Anson, Kampar and Ipoh. The settlers also received casual employment as daily-paid labourers, on a task-work basis, in the capital and maintenance works of the Drainage and Irrigation Department. In 1936 they received a total of $40,000 in wages and supplied all the labour required

* kampong = village

for maintenance, which thereafter averaged $10,000 a year (the capital cost totalled $500,000 pre-war). They were also allowed to cut, from the adjacent forest reserves, duty-free timber for houses and canes for baskets, fish-traps and direct sale. Social amenities were provided in the form of two Malay schools (1936 and 1937) and two local weekly fairs which opened for the sale of farm and handicraft products as well as household supplies from Telok Anson; the first penghulu* took up his duties in 1937.

The 10,000 acres of Stages I, II and III were colonised before the occupation of Malaya by the Japanese in 1942, and a new main canal, 11 miles long, from the Sungei Batang Padang to the Sungei Kinta was completed as well as much of the internal drainage and irrigation system for the extension of the scheme into the jungle to the west (Stages IV and V). Colonisation of stage IV (9,000 acres) was less popular owing to poor access, lack of amenities and fear of flooding. In Stage IV, before the war, the Government assisted in clearing the jungle by providing daily-paid labour, and a felling subsidy of $33 per acre was paid after the war. It was not until about 1953 that Stage IV was fully colonised; some 91 holdings were reported as abandoned in December, 1955. The additional 5,000 acres of Stage V are therefore held in reserve.

Alienation

Jungle land was alienated to applicants only after cadastral survey and the provision of irrigation and drainage facilities. Originally, permanent titles to the land were issued immediately, but from 1935 onwards a Temporary Occupation Licence (T.O.L.) was issued first, with the permanent title given only after the land was completely cleared and established. This introduced greater control over the applicants and it was easier to ensure that they were *bona fide* pioneer settlers and padi planters.

Padi lots were finally alienated to individual farmers with a permanent title (Entry in the Mukim† Register) giving ownership in perpetuity, subject to certain Land Code and cultivation conditions, with annual quit-rents and water-rates.

Size of Holding

The land was alienated to farmers as individual surveyed lots, or small-holdings, which average just over five acres throughout the scheme. The official policy at Stage I was to issue lots of four acres, though this was later changed to six acres for all the other stages.

It proved impossible in practice to issue lots of exactly the official size and to conform with the previously designed irrigation layout. There are, therefore, some lots of four acres in the later stages and some of as large as 7½ acres in Stage I, which shows the greatest range in holding size (Table I).

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* penghulu = a headman of a small district.
† Mukim=Parish.

LAND USE

The scheme was designed as an irrigated padi area and land was alienated with the condition that padi should be cultivated. Settlers in Stages I, II and III were allowed, however, to convert up to about half an acre (or 10 per cent of the lot area) into "tambak" or raised land for use as a house site and for kampong use as a fowl and fruit tree area. This does allow the farmer to live immediately adjacent to his growing crops, though for padi this is of much less importance either for cultivation-care or for larceny control than with other crops. It has the effect also of limiting the extent of dry-land food cropping and increases the average cost of irrigation per acre by reducing the area under padi.

Obviously, settlers coming from outside the Lower Perak District and from other states had to be given extra land, and consequently Stage IV farmers were promised two acres of separate kampong land in a belt on either side of the main canal which ran on higher land to the north of their padi land.

The lot acreages in the earlier stages include the kampong areas alienated for house site and mixed cultivation, whilst those in the later stage exclude them. The difference in area of padi land on lots in the earlier and the later stages would therefore have been greater than the difference in area of alienated lots shown in Table I.

Table I

LOT SIZE

Distribution of Alienated Lots by Size of Lot Within Each Stage

Size of Lot (acres)	Stage I		Stage II		Stage III		Stage IV		Total Lots All Stages	
	Lots	%	Lots	%	Lots	%	Lots	%	Lots	%
2 & below 3	222	15	—	—	—	—	—	—	222	6
3 „ „ 4	407	29	—	—	—	—	19	1	426	12
4 „ „ 5	592	42	37	9	19	6	55	4	703	19
5 „ „ 6	74	5	92	23	74	25	1,000	66	1,240	34
6 & over	130	9	278	68	203	69	444	29	1,055	29
Total	1,425	100	407	100	296	100	1,518	100	3,646	100
Average Size of Lot	3.98		5.79		6.14		5.86		5.14*	

* Average size of Sungei Manik lot = 5.14 ± 0.0850 acres, i.e. 1.7 per cent Sampling Error.

This plan for separate kampong areas was finally drafted in 1937 and it was intended to issue kampong land along the Stage IV main canal "so that each successful padi cultivator shall have an area of kampong land proportionate to his holding of padi land, ... traditional Malay Settlement

Table II

LAND USE

Area of Land under Padi, Kampong, or Uncultivated Within Each Stage (acres)

Land Use	Stage I		Stage II		Stage III		Stage IV		All Stages	
	Area	%	Area	%	Area	%	Area	%	Area	%
Padi	5,149	91	1,879	80	1,546	85	5,744	65	14,318	76
Kampong	211	4	292	12	249	14	1,242	14	1,994	11
Uncultivated	314	5	191	8	23	1	1,911	21	2,439	13
Total Alienated Area	5,674	100	2,362	100	1,818	100	8,897	100	18,751*	100

* Total official acreage = 18,603 acres.

Table III

RESIDENCE

Percentage Distribution of Farmers Within Each Stage Who Reside on the Padi Lot

	Stage I	Stage II	Stage III	Stage IV	All Farmers
Resident	58	46	76	72	62
Non-resident	42	54	24	28	38
Total	100	100	100	100	100

at its best ..... and will have the amenities of domestic water supply, health, educational facilities, sites for mosques, public buildings, village greens and grazing grounds'' (3).

The kampong and padi land lots were intended to be issued together on tied titles—a system which raises theoretical difficulties of registration and land transaction, and would in practice have broken down under the strongly fragmentary influence of Muslim inheritance laws. In fact, the plan has been found to have been largely nullified by the earlier settlers, since much of this kampong belt was already occupied by farmers from Stages I, II and III, whilst many Stage IV farmers have not yet received kampong land and are living on their padi lots (Table III).

The actual land use is shown in Table II. About three-quarters of the whole area is planted with padi, and the proportion is least in Stage IV. Some isolated patches of high land amounting to 8 per cent of the area in Stage II were always recognised as being unirrigable, and Stage II contains a high proportion of kampong land in spite of having the lowest proportion of farmers resident on their padi lots.

Class of Land

The padi land in the Scheme has been classified into three groups, following the practice in the older irrigated area of Krian in North Perak, to permit differential water-rates to be assessed on the basis of average yields of padi.

The principles of assessment were laid down in 1938 when it was decided that for three years after irrigation (or settlement, if this was considerably later) no water-rates would be levied. For the next five years, water-rates of $3, $2 and $1, respectively, would be levied per acre of land in Class 1 (yield of over 600 gantangs* per acre) Class 2 (400 to 599 gantangs) and Class 3 (below 400 gantangs). In the first year of imposition, only half these rates were collected. Eight years after initial settlement, the classification of individual lots was changed to conform to the Krian scale (Class 1: 400 gantangs and over; Class 2: 250 to 399 gantangs; Class 3: below 250 gantangs).

These rates have been raised since the war but for Class 1 land they still represent a nominal sum in comparison with the rents farmers are willing to pay their landlords, and for Class 3 land they represent now, as before the war, less than two days' labourer's wage per acre.

When land has been fully cleared and regularly produces higher yields, it is relegated to the higher classes, the individual lots being enumerated in the Government *Gazette*. Whilst Stages I and III are almost wholly Class 1 land, Stage IV is largely Class 3 (Tables IV and V). Over the whole scheme, about half of the area and rather more than half of the lots (owing to the small lot size in Stage I) is considered Class 1 land.

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* 1 gantang = 1 gallon.

Fragmentation of Holdings (By Cultivation)

Fragmentation of holdings, in the sense of the cultivation of an individual lot by more than one farmer, has occurred in all stages of the scheme, even in the most recent, post-war Stage IV. One Sungei Manik lot in five† is cultivated by two or more farmers (Table VI). Although the land was issued originally to individual farmers, there is now an average of 1.27 farmers per lot, and the overall average area available for each farmer on any single lot has fallen to 4.05 acres, from the overall average of 5.14 acres per surveyed lot.

Table IV

CLASS OF LAND

Distribution of Padi Lots by Class of Land Within Each Stage

Class of Land	Stage I		Stage II		Stage III		Stage IV		All Stages	
	Lots	%	Lots	%	Lots	%	Lots	%	Lots	%
1	1,203	84	185	45	259	88	389	26	2,036	56
2	222	16	185	45	37	12	37	3	481	13
3	—	—	37	10	—	—	1,092	71	1,129	31
Total	1,425	100	407	100	296	100	1,518	100	3,646	100

Table V

CLASS OF LAND

Distribution of Acreage of Padi Lots by Class of Land Within Each Stage

Class of Land	Stage I		Stage II		Stage III		Stage IV		All Stages	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
1	4,843	85	1,082	46	1,619	89	2,209	25	9,753	52
2	831	15	1,091	46	199	11	218	2	2,339	12
3	—	—	189	8	—	—	6,470	73	6,659	36
Total	5,674	100	2,362	100	1,818	100	8,897	100	18,751	100

† 20.31 per cent ± 2.8 of the lots, i.e. 13.8 per cent Sampling Error.

Table VI

FRAGMENTATION

The Frequency and Extent of Fragmentation Within Each Stage (Distribution of Lots by the Number of Farmers on the Lot)

No. of Farmers on the Lot	STAGE								Total Lots in All Stages	
	I		II		III		IV			
	Lots	%	Lots	%	Lots	%	Lots	%	Lots	%
1	1,222	86	92	23	222	75	1,370	90	2,906	80
2	185	13	148	36	74	25	148	10	555	15
3	18	1	129	31	—	—	—	—	147	4
4	—	—	19	5	—	—	—	—	19	1
5	—	—	19	5	—	—	—	—	19	1
Total	1,425	100	407	100	296	100	1,518	100	3,646	100
Av. No. of Farmers per Lot	1.16		2.32		1.25		1.10		1.27*	
Av. Acreage per Farmer on Each Lot	3.45		2.50		4.91		5.34		4.05	

* Average number of farmers cultivating on each lot = 1.27 $\pm$ 0.042 farmers, i.e. 3.3 per cent Sampling Error.

Table VII

FRAGMENTATION

The Frequency and Extent of Fragmentation Within Each Size Group (Stages I, II, III only) and Percentage Distribution of Lots by the Number of Farmers on the Lot

No. of Farmers on the Lot	Lot Size (acres)					Percentage of All Lots
	2 –	3 –	4 –	5 –	6 –	
1	100	82	86	61	45	72
2	—	14	14	39	27	19
3	—	4	—	—	21	7
4	—	—	—	—	3	1
5	—	—	—	—	3	1
Total	100	100	100	100	100	100

Table VIII

NON-FRAGMENTATION

The Percentage of Unfragmented Lots in Each Size Group, by Class of Land (Stage I, II, III only)

Percentage of Lots With One Farmer	Lot Size (acres)					Percentage of All Lots
	2 –	3 –	4 –	5 –	6 –	
a) Class 1 Land	100	79	81	66	52	74
b) „ 2, 3 Land	100	100	100	50	25	68

Table IX

PADI FARM SIZE

Distribution of Farmers by Size of Padi Farm Within Each Stage

Size of Farm (acres)	Stage I		Stage II		Stage III		Stage IV		All Stages	
	Farmers	%	Farmers	%	Farmers	%	Farmers	%	Farmers	%
Below 1	18	1	74	9	—	—	19	1	111	3
1 –	231	17	370	43	56	16	194	13	851	20
2 –	352	25	194	24	74	21	148	10	768	19
3 –	426	30	102	13	37	10	361	24	926	22
4 –	74	5	56	7	37	10	324	21	491	12
5 –	111	8	18	2	93	26	287	19	509	12
6 –	102	8	28	4	18	5	92	6	240	6
7 –	55	4	9	2	28	10	28	2	120	3
8 and over	37	3	–	–	9	2	65	4	111	3
Total	1,406	100	851	100	352	100	1,518	100	4,127	100
a) Av. Size of Farm (acres)	3.73		2.24		4.28		4.00		3.57	
b) Av. Area Uncultivated per Farmer (acres)	0.22		0.22		0.06		1.26		0.59	
Maximized Av. Size of Farm on Completion (a) + (b)	3.95		2.46		4.34		5.26		4.16	

Some time often elapses before holdings are shared, after the jungle-forest growth has been cleared and the land is in almost complete cultivation. Fragmentation has, however, already appeared in Stage IV in 10 per cent of the lots, but, at most, two farmers cultivate on the same lot. In Stage II, fragmentation is most evident (77 per cent of the lots) and to the highest degree, with as many as five farmers on the same lot, and at least three farmers on as many as 40 per cent of the lots (Table VI).

Fragmentation has occurred mainly on holdings in the larger size-groups. Table VII shows what proportion of lots within each size-group have been fragmented in Stages I, II and III (Stage IV has been excluded because the process has scarcely begun and much land is still uncultivated). One-quarter of the lots of six acres or more in size have three or more farmers cultivating each lot, and over one-half have two or more. In the five-to-six acre size group, four out of ten lots are fragmented, but to a smaller extent.

The class of land obviously influences the probability of subdivision, since on the better, Class 1 land, smaller acreages of padi per farmer are encouraged by the higher income and greater labour demands per acre. Also, tenant farmers have first appeared on the Class 1 land. Fragmentation has not appeared in lots of less than three acres on Class 1 land nor in lots of less than five acres in the lower classes (Table VIII). In all classes, fragmentation is more likely in the larger size groups.

There is apparently a conflict between the standards of the Government and those of the farmers over the size of padi holding suitable for farming as one unit, having regard to different land fertility. The Government's plans have, of course, to be made before all the facts are known (e.g. how fertile the jungle land will become after full clearing) whilst the farmers have the benefit of experience. On first and second class of deep land suitable only for manual cultivation, the majority of farmers cultivate less than five acres each (Table X); and consequently the issue of six-acre lots in Stage II has resulted in more fragmentation than the issue of four-acre lots in Stage I (Table VI), even though Stage I is predominantly Class 1 land (Table V) and is of course somewhat longer settled.

Consolidation of Holdings

Fragmentation of holdings may be complementary to the construction of larger farms from several fragments of holdings. Where lots are small, two whole lots or more are sometimes cultivated by the same farmer. Fragmentation of holdings is also related to the rise of tenant farmers who are willing to rent portions of lots, if a whole lot is not obtainable, even on the relatively small three-to-four acre lots of Stage I. One farmer in eight in Sungei Manik cultivates two or more lots, either in part or whole.

The Sungei Manik Scheme illustrates the distinction between the "padi holding", i.e. an alienated lot*, and the "padi farm", i.e. the whole area of land occupied as one economic unit by a farmer for the cultivation of padi, whether in a single or in several lots, whether in one compact area or scattered, and whether owned or rented.

Fragmentation of Holdings (By Ownership)

The first licence to occupy the lot is given to a single individual who, having cleared the land, is then granted an Approved Application (A.A.) prior to his final permanent document of title (Entry in the Mukim Register or E.M.R.). The process of land clearing and registration occupies several years (41 per cent of the lots in the three Stages colonised before the war had not received a permanent title at the 1st January, 1956). Consequently, owing to the system of "berkongsi" (joint ownership), and to the Muslim laws of inheritance, many permanent titles are issued already fragmented. One lot in seven in Sungei Manik on first registration as an E.M.R. was subject to shared ownership among two or more owners (10 owners was the highest number recorded among the surveyed lots). Fragmentation and distribution of course continue after registration but are frequently not reported by Malay peasants until after a considerable time lag; so the present Land Office Mukim Registers perforce understate the real degree of fragmentation at any one time. At the time of the survey in March, 1955, the Registers showed, however, that one padi lot in every five with a permanent title is subject to fragmentation of ownership.

Arrears in the Registration of Ownership

The survey obtained ownership details of holdings where the cultivator was the owner-farmer, at least in part. The owner of the holding at the time of survey could then be compared with the owner registered in the permanent and temporary titles at the Land Office. One-quarter of these owner-farmer holdings in Stages I, II and III, settled before the war, and one-third of the holdings in Stage IV had incurred an unregistered change of owner. This is a high rate of land transfer and requires a more flexible system of title documentation and more incentives for peasants to register their dealings than exist at present.

Size of Padi Farm

In the Sungei Manik Scheme as a whole, the average area of padi land cultivated by a single farmer as one unit is just over 3½ acres. The average farm is smallest in Stage II (2½ acres) and largest in Stage III (4¼ acres). The proportion of farmers within each size-group in the different stages is shown in Table IX.

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* A "smallholding" for padi, rubber, fruit, etc., in the usage of the Malayan Department of Statistics correctly indicates a surveyed lot, usually under a single title in the Land Office Register with a particular crop sometimes specified for cultivation at the time of original alienation. Too frequently the term is extended, inaccurately, to mean an economic farming unit under that crop, even though it may, in fact, be fragmented, or consolidated with other lots, or even planted with another crop altogether.

At present there is uncultivated land in the scheme, so the average size of farm will increase when all the jungle land is completely cleared. The area of alienated land which is uncultivated is considerable only in Stage IV (where it forms 21 per cent of the alienated area).

All lots have now been alienated to settlers, with the exception of 91 lots (1st January, 1956) in Stage IV; it is therefore possible to estimate for the settled area the final size of farm, but only if it is assumed that (i) no more farmers will enter the scheme and (ii) all the land at present uncultivated will become padi land and not kampong. The maximum possible average size of farm for each stage on final completion is shown at the bottom of Table IX (maximized average size of padi farm), and for the whole of Sungei Manik averages just over four acres.

A few farmers in the largest size-group (eight acres and over) are also cultivating padi land outside the scheme, in their former kampongs in Perak, Kedah and Perlis. This is probably a temporary arrangement until their Sungei Manik farms are fully developed. Their Sungei Manik farms, considered by themselves, fall into considerably smaller size-groups.

The largest farms are found on Class 3 land (Table X) even though in this area much land has still to be cleared (an average of $1\frac{1}{4}$ uncleared acres per farmer). The probable final size of farm on Class 3 land ($5\frac{1}{4}$ acres) will then be half as large again as those on Class 1 land ($3\frac{1}{2}$ acres).

The average size of padi farm on Class 2 land ($2\frac{3}{4}$ acres) is considerably smaller than either Class 1 or 3 farms. Relatively more of these Class 2 farmers were previously living in Lower Perak, so their padi holding in the Sungei Manik Scheme may be an extension to their present farms, and many more of these farmers admitted* controlling other areas of coconuts, rubber and kampong land. Furthermore, fewer farmers in Stages I and II (which contain the majority of the Class 2 land in Sungei Manik) live on their padi lots. Farmers to whom padi is only one crop in a mixed farm will tend to cultivate a smaller acreage of padi land.

THE "KONGSI" (PARTNERSHIP)

State land in the Scheme is first alienated under a Temporary Occupation licence (T.O.L.) to one claimant. However, owing to the demand for land and the delays in obtaining T.O.L.s, an approved T.O.L. for a lot of uncleared jungle land is saleable immediately for $150 to $200, although officially the T.O.L. gives no transferable title to the land but only permission to cultivate, which is forfeitable if

* The answers to this question in a survey of a newly developed area are subject to considerable bias. The land Office application forms for newly alienated state land frequently request similar information, almost always resulting in a "Nil" answer since it is well known that applications are more favourably received from the poorer farmers in any area. The Malayan Land Office Registration system makes it impossible to check on the replies.

Table X

PADI FARM SIZE

Distribution of Farmers by Size of

Padi Farm Within Each Class of Land

Size of Padi Farm (acres)	Class 1		Class 2		Class 3		All Classes	
	Farmers	%	Farmers	%	Farmers	%	Farmers	%
Below 1	18	1	74	11	19	1	111	2
1 –	491	21	222	32	138	14	851	21
2 –	537	23	120	17	111	10	768	19
3 –	546	23	130	19	250	24	926	23
4 –	213	9	56	8	222	20	491	12
5 –	278	12	56	8	175	17	509	12
6 –	139	6	18	3	83	8	240	6
7 –	102	4	—	—	18	2	120	3
8 and over	28	1	18	—	65	6	111	2
Total	2,352	100	694	100	1,081	100	4,127*	100
Average Size of Padi Farm (acres)	3.56		2.82		4.05		3.57†	

* ± 148 farmers, i.e. 3.6 per cent Sampling Error. The number of farmers is obtained by weighting the farmers in the survey in inverse proportion to the number of lots on which they were cultivating, i.e. to their chances of selection in the sample.

† ± 0.1377 acres, i.e. 3.9 per cent Sampling Error.

Table XI

TENANCY

Area Under Different Forms of Tenancy Agreement Within Each Stage

Tenancy Agreement	Stage I	Stage II	Stage III	Stage IV	All Stages	
	Acres	Acres	Acres	Acres	Acres	%
Padi-Renting	745	375	—	160	1,280	67
Crop-Sharing	544	—	—	—	544	28
Cash-Renting	50	35	—	—	85	4
Rent-Free (as interest on a loan)	23	—	—	—	23	1
Total	1,362	410	—	160	1,932*	100
Total Padi Area	5,149	1,879	1,546	5,744	18,751	
Area Rented as Per Cent of Total Padi Area	26	22	Nil	3	10	

* ± 322 acres i.e. 16.7% Sampling Error.

the licencee does not immediately start clearing. A second settler, particularly if from another state or another area in Perak, is willing to clear the whole lot area from jungle as a partner, on the understanding that the land, as it is cleared, will be shared equally between the two men. When the land is fully cleared and a permanent Land Office title is issued, both men will be co-owners with equal shares in the Entry in the Mukim Register. Any charges for survey or title fees will be payable by the original T.O.L. holder.

In a system of "berkongsi", the original T.O.L. holder therefore provides the whole of the costs of title registration whilst the second partner contributes the whole of the labour of clearing the land. Occasionally, before the permanent title is issued, one partner will sell out his interest in the land to the other (at prices varying according to the area cleared, the distance to the road or irrigation canal, etc.).

Partnerships of this type are, of course, made only in the initial stages of colonisation, i.e. at present in Stages III and IV, where much of the land is still occupied under T.O.L. Approved Application (A.A.). In these stages one farmer in nine is a partner and such partnerships cover 6 per cent of the alienated lots (mainly the larger lots) and 9 per cent of the alienated acreage.

Tenancy

More than one lot in six* (or one acre in ten) is rented in part or in full over the whole Sungei Manik Scheme, where every sixth farmer is a tenant. Tenancy is almost confined to the first two stages, where it appears largely on the Class 1 land. One-third of this rented land is still under temporary land titles. In Stage I, where every third farmer is a tenant, one-quarter of the land is rented.

There is obviously strong competition for fully developed first-class land, in contrast to the poorer and over-grown land of the later stages (one-fifth of Stage IV is still uncultivated). The tenant farmers include two types:- (a) those farmers who prefer the life and immediate income of padi planting on rented land to the labour of clearing their own land, which may prove only third-class, and (b) those who want a certain padi crop (even reduced by rent) for their subsistence whilst engaged in the clearing of another piece of virgin land for their own farm.

Fortunately there are many particularly fine types of Malay peasant who willingly undertake, for the future benefit of their families, the arduous work of jungle felling and land clearing while living in primitive conditions. But there are many others to whom it does not appeal.

The clearing of jungle involves a capital investment and many farmers are unable financially to wait through the clearing period for a return. Others, with capital or rents from other land, will be able to make the investment with the prospect of owning cleared farm land which will always be a saleable or rentable asset in the future.

There are always farmers who have become tenants through incurring debts and selling their land in repayment. There are applicants in any scheme who obtain land in their own or their relatives' names and who, in fact, do not cultivate all or any of it themselves. Padi farmers in all areas of Malaya are familiar with the landlord system of at first renting new land at nominal rents, which are then gradually increased as the land becomes fully developed.

Forms of Renting

Rents in padi (a previously agreed amount-per-area, paid at harvest) are most usual and are paid, on two-thirds of the area of tenanted land, by two out of three tenant farmers.

The rents are calculated either on a unit area of land (the large *relong* ($1\frac{1}{8}$ acres) is more understood than the English acre, which is the unit of survey) or on the whole piece of land rounded off to the nearest unit of area.

* 17.26 per cent $\pm$ 2.62 of the lots, i.e. 15.2 per cent Sampling Error.

The rents paid on Class 1 land vary from 100 *gantangs* per acre down to 30 or 40 *gantangs* (where the tenant is a friend or relative) and average 80 *gantangs* in Stage I, 60 *gantangs* in Stage II and 50 *gantangs* in Stage IV. The farmers and their landlords are apparently more discriminating in their classification for padi rents than is Government for its irrigation water rates.

Equal shares (*pawah bagi dua*) between landlord and tenant is the second system, which accounts for nearly 30 per cent of the tenanted land and for one tenant in four, all on Class 1 land within Stage I. The system offers some flexibility since the sharing takes place either after the first farming operation of weed slashing (*menajak*), after transplanting, after the crop is ready for harvest or after the harvest. In the first three methods, the land is shared equally by area; in the last the cleaned grain is shared equally by volume. An estimate of the relative importance of the four possible methods (either by area or by the number of practising farmers) is unfortunately not possible, since some recorders did not enquire all the details of each tenure system.

Renting in cash, averaging $50 per acre, paid in advance, does occur, but not to any significant extent at the moment. A few farmers have obtained the use of land rent-free for two or three years in return for a loan of a large sum of money to the landowner. There is evidence of a high turn-over of tenants, since one-third of all farmers on Stage I have been farming the same land for up to five years, but one-third of the tenant farmers have been farming the land for only one year. High prices for rubber periodically offer alternative livelihood to settlers.

It is probable that the Sungei Manik Scheme will, in time, stabilise its systems of padi land tenure on a pattern rather similar to that of the Krian Irrigation Area in North Perak, with generally higher padi rents than at present and with cash-renting and crop-sharing reversing their present roles.

Summary

The main features of padi farm structure have been outlined, i.e. the sizes of operated farms and the sizes of the alienated holdings from which they evolve by processes of fragmentation and consolidation. Fragmentation of the ownership of padi land is mentioned, together with a description of the partnership methods of the pioneer settlers on the newer land and of the systems of renting now becoming established in the fully settled areas.

Recommendations

Surveys collecting economic data from Malayan peasant farmers with their complicated and highly evolved systems of farm organisation should be undertaken only if sufficient time can be given by adequately trained and supervised staff.

Economic surveys of Malayan peasant farmers should be based not on the names of the landowners in the Land Office registers (which are subject to considerable inaccuracy) but on the farmers actually cultivating the selected areas, as was done with the present survey. This presupposes the use of recording staff trained to the standard of Agricultural Assistants or Irrigation Inspectors to identify in the field the particular areas selected in the sample.

Government settlement schemes should be completely planned at the outset and farm layout should be designed at the same time as canal alignment, for it may not be possible to introduce amendments, e.g. increasing the amount of kampong land, successfully at a later date.

The sizes of Government holdings in the form of the surveyed lots should conform with the areas which individual farmers normally farm as one unit under a particular system of farming. These will be 4½ acres at most for potential first and second class padi land and not much above 5 acres for inferior land, where manual soil preparation is to be used. Larger sizes than these will result in excessive fragmentation.

Padi farmers should be allowed to cultivate kampong land as an integral part of their farms, and this should be larger than half an acre in size, possibly one acre and preferably, for social and economic reasons, not subject to irrigation.

The Torrens system of registration of titles together with the additional Malayan procedure should be more flexible and curtailed in order to end the present paradox of hardworking and overworked Land Offices falling into arrears of 10 years or more in their alienation of titles for new land in a scheme which is only 23 years old. Delay in the issue of permanent titles is a discouragement to farmers in any land development scheme.

Jungle clearing for padi land involves a very considerable investment of private capital in the form of subsistence and even sacrifice of wages in alternative employment for at least four years. All extraneous costs, and particularly those involving cash payments (and therefore an exaggerated valuation by the peasants), should be eliminated. The costs incurred in survey, registration and title issue should not be equivalent to the labour involved in clearing the holding, which they now are, viz. in the "berkongsi" agreements.

The poorer pioneers, without the full investment resources to undertake the work of clearing jungle land, are nevertheless very desirable settlers and should be encouraged by Government in the initial period of clearing the first one or two acres of their holdings by the loan of a small area of cleared padi land on a rotational basis; this applies especially to those settlers who at present rent padi land for their subsistence.

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MINERAL NUTRITION OF PADI

I. Nitrogen and Phosphorus Uptake of Padi Grown on an Extremely Poor Lateritic Soil, Compared with that of Dry Land Crops

BY

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Introduction

Den Berger, in Java in 1909, concluded that all the nutritive elements, with the exception of nitrogen and phosphorus, are supplied by irrigation water in sufficient quantities to replenish the losses of these elements when they are absorbed by the padi plants. This is rather a broad statement, for there are many instances where the padi plant under irrigation has suffered from other deficiencies, but they are of little importance compared with the deficiencies of the two elements under consideration.

There is some literature on the application of nitrogen and phosphorus to wet padi, but little precise work and practically no comparative work has been carried out with dry land crops. An experiment was therefore laid out to investigate the uptake of nitrogen and phosphorus by padi plants on an extremely poor sandy soil (Seddon Series from Kangaroo Island, South Australia). Results of pot experiments on this soil, using oats and subterranean clover, were available for comparison.

The lay-out of the experiment was as follows:-

Treatment No.	Treatment	Replicates
1	N_3P_3	6
2	N_3P_6	3
3	N_3P_{12}	3
4	N_6P_3	3
5	N_6P_6	3
6	N_6P_{12}	3
7	N_9P_3	3
8	N_9P_6	3
9	N_9P_{12}	3
10	N_9P_0	3
11	N_0P_{12}	3

The treatments N_0P_0, N_0P_3, N_0P_6, N_3P_0, and N_6P_0 were excluded at the suggestion of Prescott* as it was known that the soil was deficient in nitrogen and phosphorus.

Details of the Experiment

TREATMENTS

The experiment was carried out in enamel pots of 9 in. diameter, each containing 13.3 kg. of air-dried soil. All treatments received a basal dressing of potassium and the micronutrients copper, zinc, manganese and molybdenum were applied to the soil in solution form. The nitrogen used

* Personal communication.

in the experiment was added in the form of dilute ammonia solution and the superphosphate was added in solid form and thoroughly mixed with the top 2 in. of the soil. Germinated padi seeds, variety Caloro 2, were planted in the pots at approximately 24 seeds per pot and were later thinned out to six seedlings per pot. Only distilled water was used for watering and it was added in increasing quantities until the level of the water was 2 in. above the surface of the soil. This level was maintained by addition of distilled water. The pots were not drained.

The pots were completely randomised in a single block in an open glass house. They received the nitrogen equivalents of 3, 6 and 9 cwt. of ammonium sulphate per acre. The equivalent of 2 cwt. was applied a fortnight after germination, followed by the equivalent of 1 cwt. at intervals of 10 days until the required amount had been added. Twenty-five ml. of 0.33 N solution of ammonia per pot contained the nitrogen equivalent of 1 cwt. of ammonium sulphate per acre. Phosphorus was added in the form of superphosphate (21.4% P_2O_5). A dressing of 1.632 gm. of superphosphate per pot was equivalent to 3 cwt. per acre.

Harvesting of Padi Plants

In harvesting padi plants for experimental purposes it is usual for the stems to be contaminated with soil particles. These particles adhere to the lower part of the stem which was previously in contact with water. In order to overcome this, Prescott suggested* that the padi plants, with their roots, should be dug up and the stems washed thoroughly before severing at the base of the stems. In practice it was found convenient to dig up the plants complete with their roots, wash them lightly, sever them at the bases of the stems, separate the old, dried stem tissue which contains all the soil particles and wash this dried, contaminated tissue thoroughly. In field experiments it may be more convenient to discard all dried tissue in taking samples, as it is negligible in weight by comparison with the remaining aerial portion of the plant (2 to 5 per cent) but is a dangerous source of contamination.

Analytical Methods

The padi plants were harvested at maturity using the same procedure that had been followed by Tyson (7), who worked on oats and subterranean clover on the same soil. The above-ground portions of the plants in each pot constituted a sample. The samples were dried to constant weight in an air oven (for about a week at approximately 60° to 70°C), weighed and then ground in a Christie and Norris Junior mill. Nitrogen was determined by the Kjeldahl method using potassium sulphate, copper sulphate and selenium to aid in the digestion. About 1 to 2 gm. of the dry, ground material was used for each nitrogen determination. The wet digestion method, using sulphuric, perchloric and nitric acids, was followed. Phosphorus was determined by a modification of the "Lorenz" method as given by Piper (6). The individual results of the analyses are given in Table I.

* Personal communication.

Table I

Results Obtained with the Seddon Soil
Nitrogen and Phosphate Series
Padi (Caloro 2)

Pot No.	Treatment	Max. No. of Tillers per Pot	No. of Flowering Tillers per Pot	Yield per Pot (gm.)	N in Dry Matter (per cent)	Uptake of N per Pot (mg.)	P in Dry Matter (per cent)	Uptake of P per pot (mg.)	pH
4		29	23	40.2	.473	194	.218	88	
7		28	21	38.0	.476	181	.220	84	
8		29	23	42.9	.470	202	.213	91	
18	N_3P_3	29	26	41.6	.476	198	.214	89	6.5
20		29	26	44.0	.459	202	.216	95	
27		25	23	37.6	.470	177	.230	87	
29		30	25	41.2	.453	187	.287	118	
30	N_3P_6	30	25	41.2	.450	185	.311	128	—
33		28	25	44.2	.466	206	.298	132	
35		31	23	40.7	.468	190	.365	149	
38	N_3P_{12}	33	25	42.3	.497	210	.376	159	6.5
46		33	24	41.1	.468	192	.333	137	
49		34	26	43.7	.468	205	.217	95	
53	N_6P_3	33	28	49.1	.463	227	.193	95	—
65		32	26	45.2	.467	211	.209	95	
69		37	29	50.1	.449	225	.276	138	
70	N_6P_6	38	29	54.9	.453	249	.292	160	6.2
72		37	28	52.0	.468	243	.288	150	
75		36	32	52.0	.475	247	.364	189	
84	N_6P_{12}	43	32	56.9	.444	253	.359	204	6.3
85		40	28	54.4	.514	278	.351	191	
88		31	31	63.7	.488	316	.167	108	
94	N_9P_3	36	30	66.0	.499	329	.174	115	6.1
112		37	31	64.3	.506	325	.163	105	
119		34	34	70.1	.525	368	.266	187	
122	N_9P_6	34	33	71.1	.479	341	.288	205	5.9
129		37	35	68.5	.450	308	.262	180	
147		41	36	74.0	.482	357	.321	238	
152	N_9P_{12}	36	34	73.6	.536	395	.361	266	6.0
168		42	33	75.8	.498	378	.337	256	
178		6	0	1.1	—	—	—	—	
35	N_9P_0	6	0	1.5	—	—	—	—	6.2
286		6	0	1.2	—	—	—	—	
279		23	22	33.0	.520	172	.361	119	
320	N_0P_{12}	19	17	31.2	.519	162	.369	115	6.2
379		22	19	29.5	.539	159	.377	111	

Basal Treatment: K_2SO_4 .. 56 lb. per acre;
$CuSO_4.5H_2O$ .. 14 lb. per acre; $ZnSO_4.7H_2O$ .. 14 lb. per acre;
$MnSO_4.4H_2O$ .. 56 lb. per acre; $Na_2MoO_4.2H_2O$ .. 1 lb. per acre.

Results

Mean Yields

The mean yields for the different levels of nitrogen with various levels of phosphate are summarized in Table II.

Table II

Mean Yields of Padi (Grain and Straw)
(gm. per pot)

Treatment	N_0	N_3	N_6	N_9	Mean	Mean of All Treatments
(P_0)	—	—	—	(1.3)*	—	
P_3	—	40.7	46.0	64.7	50.5	
P_6	—	42.2	52.3	69.9	54.8	
P_{12}	31.2	41.4	54.4	74.5	56.8	48.6
Mean		41.4	50.9	69.7	54.0	

* The mean yield for the treatment N_9P_0 was extremely low—only 1.3 gm. The plants practically stopped growing in about two weeks. No analysis was made for nitrogen or phosphorus in the samples.

Sig. Diff. at	5%	1%	0.1%
Body of the Table	3.44	4.67	6.27
Means	1.99	2.70	3.62

Nitrogen

Nitrogen Content and Uptake

The mean percentage nitrogen content in the dried material is given in Table III.

Table III

Mean Percentage Nitrogen Content of Dry Material

Treatment	N_0	N_3	N_6	N_9	Mean
P_3	—	.471	.466	.498	.478
P_6	—	.456	.457	.485	.466
P_{12}	.526	.478	.478	.505	.487
Mean		.468	.467	.496	.477

Sig. Diff. at	5%	1%
Body of the Table	.0323	.0438
Means	.0186	.0253

The analysis for nitrogen in the samples (straw, and grain which was largely unfilled) seems to indicate that taking into account only the percentage nitrogen in the sample without considering the yield would give rise to erroneous conclusions. The percentage nitrogen did not vary much although the mean of all the treatments receiving 9 cwt. per acre was significantly higher than all other nitrogen treatments. On the other hand, the treatment with no application of nitrogen had the highest percentage nitrogen and, as shown in Table III, was statistically significant as compared with the N_3 and N_6 treatments. The number of tillers was also dependent on the amount of nitrogen applied (cf. Table I).

The mean uptake of nitrogen in gm. per pot (for only the above-ground portion of the plants) is given in Table IV.

Table IV

Uptake of Nitrogen
(gm. per pot)

Treatment	N_0	N_3	N_6	N_9	Mean
P_3	—	.192	.214	.322	.243
P_6	—	.193	.239	.339	.257
P_{12}	.164	.197	.260	.376	.278
Mean		.194	.238	.346	.259

Sig. Diff. at	5%	1%	0.1%
Body of the Table	.0250	.0340	.0456
Means	.0145	.0196	.0263

There was a continuous increase in the uptake of nitrogen by the plants with increasing application of nitrogen. The uptake of nitrogen was also influenced by the addition of phosphorus at the N_6 and the N_9 levels. At the N_3 level the amount of nitrogen was so low that further application of phosphorus had no influence. An important factor was the availability to the padi plant of nitrogen naturally present in the poor sandy soil used in the experiment.

The mean uptake of applied nitrogen in gm. per pot is given in Table V. The figures were obtained by deducting 0.164 (natural nitrogen in the soil) from those in Table IV, assuming that in all cases the availability of naturally occurring nitrogen was the same. No account was taken of the nitrogen in the roots. The same procedure had been followed by Tyson (7) when he worked with oats and subterranean clover. The mean percentage of nitrogen taken up of the amount applied is given in Table VI.

Table V

Mean Uptake of Applied Nitrogen
(gm. per pot)

Treatment	N_3	N_6	N_9
P_3	.028	.050	.159
P_6	.029	.075	.175
P_{12}	.033	.095	.213

Table VI

Mean Percentage Nitrogen Taken Up of Amount Applied

Treatment	N_3	N_6	N_9
P_3	8.09	7.22	15.31
P_6	8.38	10.83	16.85
P_{12}	9.54	13.72	20.51
Mean	8.67	10.59	17.56

The figures in these tables are very striking. They show that in the initial stages very little of the nitrogen applied as ammonia was taken up and the rest was lost. Taking only the figures given for Treatment P_{12}, we find that, of the 0.346 gm. of nitrogen applied within the first month after planting, only 0.033 gm. was taken up, i.e. only 9.54 per cent of the amount applied. Assuming that the uptake of nitrogen in treatment N_6P_{12} was the same as in treatment N_3P_{12} in the first month of growth, and that the uptake of nitrogen in the treatment N_9P_{12} was the same as in treatment N_6P_{12} in the first two months of growth, we find that during the second month of growth, when the same amount of nitrogen was applied, the amount taken up was 0.062 gm. (0.095 minus 0.033 gm.) or 17.9 per cent of the amount applied. During the third month, with a further application of 0.346 gm. nitrogen, 0.118 gm. (0.213 minus 0.095 gm.) or 34.1 per cent of the nitrogen added during that period was taken up by the plants. It is apparent that the most efficient use of ammonia is made when it is applied at a time of active growth so that the padi can absorb it before it is lost to the atmosphere.

The uptake of applied nitrogen is conspicuously low when compared with the results of Tyson (7), who worked with Mulga oats on the same poor, sandy, Seddon soil. He applied the nitrogen equivalent of 0, 4, 5, 6 and 8 cwt. of ammonium sulphate per acre to similar pots containing approximately the same amount of soil. He found that without the application of nitrogen the yield was only 5.8 gm. per pot while with the nitrogen equivalent of 4 cwt. ammonium sulphate per acre the yield was 52.7 gm. per pot—that is, an increase of 11.7 gm. per pot for each equivalent of 1 cwt. ammonium sulphate added. In the case of padi the yield without application of nitrogen was 31.2 gm. and with the application of the nitrogen equivalent of 3 cwt. ammonium sulphate the yield was raised only to 41.4 gm. per pot, that is an increase of approximately 3.4 gm. for each equivalent of 1 cwt. of fertiliser. The overall percentage uptake of applied nitrogen for oats according to Tyson was 97.8, 94.7, 91.9 and 84.4 for applications of the nitrogen equivalent of 4, 5, 6 and 8 cwt. of ammonium sulphate per acre, respectively. In the case of padi the overall percentage uptake of the nitrogen applied was 8.67, 10.59 and 17.56 for the nitrogen equivalents of 3, 6 and 9 cwt. of ammonium sulphate per acre, respectively.

Discussion

The two important findings that emerged from the application of ammonia for growing padi on a very poor sandy soil were:-

(i) The major portion of the applied ammonia (over 75 per cent) was not utilized by the plants but was lost, although the natural pH of the soil was 6.3; and

(ii) The waterlogged condition seems to favour the loss of nitrogen from the artificial fertiliser applied; as a result the padi plant

under such conditions is unable to use inorganic nitrogen efficiently. There is possibly very little loss of nitrogen from artificial fertiliser under ordinary dry land conditions and the oat plant can make maximum use of applied nitrogen. On the other hand, the padi plant seems to be more capable than the oat plant of using naturally occurring nitrogen. The yield in dry matter when no nitrogen was applied was 5.8 gm. for oats compared with 31.2 gm. for padi.

The loss of nitrogen when nitrogenous fertilisers are applied to waterlogged soil has been noted by Pearsall (5) and more recently by De and Digar (1). It is quite possible that the loss of nitrogen due to oxidation, reduction, vaporisation as ammonia or other causes in a waterlogged soil may be partly a characteristic of the soil, depending on the type and quantity of clay colloids, as well as on the C/N ratio. It may also depend to some extent on the type of fertiliser used.

Phosphorus

Phosphate Content and Uptake

The amount of phosphorus present in the dry plant material was determined and the mean values for each treatment are given in Table VII.

Table VII

Mean Percentage P_2O_5 in Dry Material

Treatment	N_0	N_3	N_6	N_9	Mean
P_3	—	.218	.206	.168	.197
P_6	—	.299	.285	.272	.285
P_{12}	.369	.358	.358	.340	.352
Mean		.292	.283	.260	.278

Sig. Diff. at	5%	1%	0.1%
Body of the Table	.0205	.0278	.0374
Means	.0118	.0161	.0216

The percentage phosphorus in the dry material seems to give a good indication of phosphorus deficiency. Table VII shows that the amount of nitrogen present greatly influences the percentage phosphorus; the greatly increased growth (cf. Table I) tends to reduce the percentage phosphorus content of the dry matter. This tendency is marked when the phosphorus level of application is low and tends to diminish as the level of phosphorus is increased.

The mean uptake of phosphorus per pot is given in Table VIII. No account has been taken of the phosphorus in the roots.

Table VIII

Mean Uptake of P_2O_5
(gm. per pot)

Treatment	N_0	N_3	N_6	N_9	Mean
P_3	—	.089	.095	.109	.098
P_6	—	.126	.149	.190	.155
P_{12}	.115	.148	.195	.253	.199
Mean		.121	.146	.184	.151

Sig. Diff. at	5%	1%	0.1%
Body of the Table	.0143	.0194	.0261
Mean	.0083	.0112	.0150

Here again nitrogen shows its influence, but in this case, with application of increasing amounts of nitrogen, increasing amounts of phosphorus were taken up for the same level of phosphorus. Better growth of the root system and the greater demand of the plant for phosphorus with the application of more nitrogen may have been the chief reason for this.

The plants without phosphorus made practically no growth (dry weight of above-ground portion of plants only 1.3 gm. per pot), so it was assumed that the phosphorus taken up by those plants receiving it came almost entirely from the fertiliser applied. Analysis, also, indicated that the amount of phosphorus in the soil was exceedingly low. The amount expressed as P_2O_5 soluble in hydrochloric acid was only about 0.002 per cent.

The percentage taken up of the phosphorus applied is given in Table IX.

Table IX

Percentage Taken Up of Phosphorus Applied

Treatment	N_0	N_3	N_6	N_9
P_3	—	25.5	27.2	31.2
P_6	—	18.0	21.3	27.4
P_{12}	8.23	10.6	14.0	18.1

With adequate nitrogen, the equivalent of 9 cwt. ammonium sulphate, and with a low phosphorus application of 3 cwt. superphosphate per acre, the percentage taken up was 31.2; with adequate nitrogen and 6 cwt. of superphosphate the uptake was 27.4 per cent of the amount applied.

Tyson (7) quoted uptake figures ranging from 6.9 to 15.4 per cent for various phosphatic fertilisers using subterranean clover as the test plant on the same Seddon soil. Owen (4) grew padi plants (dry land type) in soil rich in iron and aluminium oxides and he found that his pot plants usually utilized less than 20 per cent of the added phosphatic fertiliser.

Discussion

The uptake of phosphorus by padi plants under waterlogged conditions must be considered as relatively more efficient when compared with that of subterranean clover. Taking into account the work of Pearsall (5) and the more recent work of Islam and Elahi (2) there seems to be little doubt that under waterlogged conditions phosphorus is more readily available since generally less is fixed.

Marias (3), Williams and Stewart (8) and Owen (4) have noted that application of nitrogenous fertilisers, especially ammonium sulphate, increases the availability of otherwise insoluble phosphorus. In the experiment under consideration, the increased uptake of phosphorus upon application of nitrogen may be due to increased demand by the plant as a result of increased growth and not due to phosphorus being made more available by increased solubility or by nitrification.

Summary and Conclusions

An experiment with four levels each of nitrogen and phosphorus was conducted with padi as the test plant and comparisons were made with plants under dry land conditions.

There was a great loss of nitrogen when ammonia was added to a waterlogged soil although the pH of the soil-water was about 6.5.

The nitrogen added to padi plants was rapidly utilized, the quantity required depending on the age of the plant. In the first, second and third months the uptake of applied nitrogen was 9.5, 17.9 and 34.1 per cent, respectively.

Naturally-occurring organic nitrogen is possibly more easily available to the padi plant under waterlogged conditions than it is to a plant like oats under dry land conditions.

Phosphatic fertilisers are more readily available under waterlogged conditions than under dry land conditions.

The percentage phosphorus in the dry material of plants gives a good indication of the amount of phosphorus available to the plant.

The application of nitrogen to a phosphorus and nitrogen deficient soil tends to lower the percentage phosphate in the plant, giving an indication of an interaction between nitrogen and phosphate.

Rotation of padi with legumes or with addition of nitrogen to the dry land crop in the rotation might be more profitable than addition of inorganic nitrogenous fertilisers to padi.

Acknowledgements

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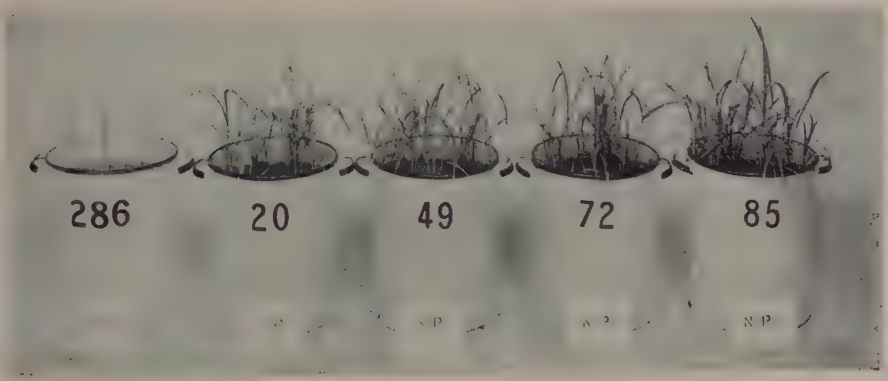
PLATE I

Effect of Applied Nitrogen on the Growth of Padi

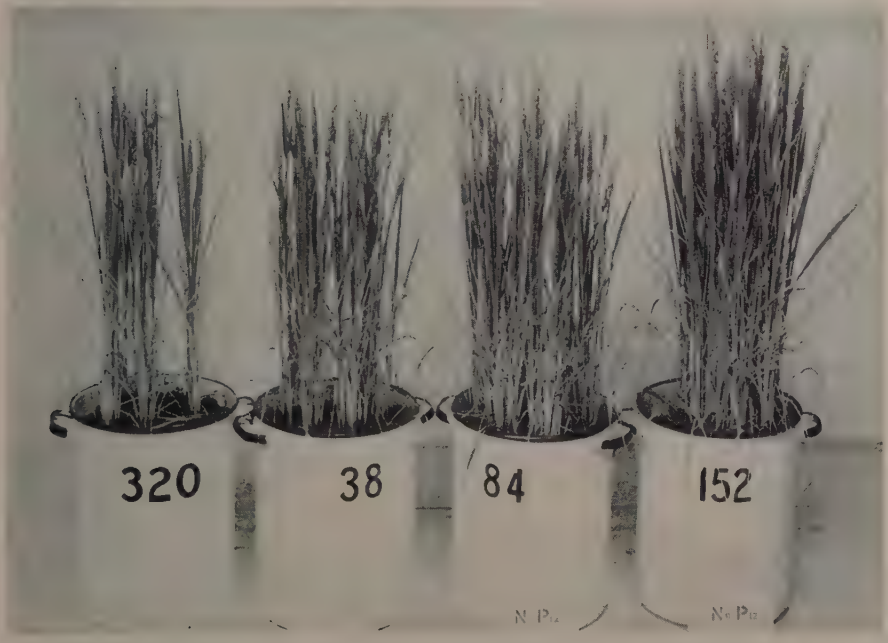


Treatment N_5P_0 N_0P_{12} Control N_3P_3 N_3P_{12} N_5P_{12}

(Photograph taken when plants were 50 days old, when N_6 and N_9 treatments had not received their full dressings of nitrogen and the amount of nitrogen applied was equivalent to 5 cwt. of ammonium sulphate)

PLATE II

Effect of Applied Nitrogen on the Growth of Padi

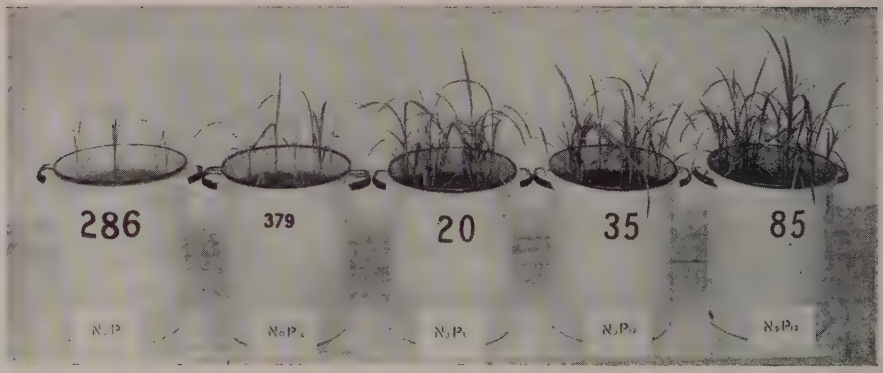


Treatment N_0P_{12} N_3P_{12} N_6P_{12} N_9P_{12}

(Photograph taken two weeks before harvesting)

PLATE III

Effect of Applied Phosphate on the Growth of Padi

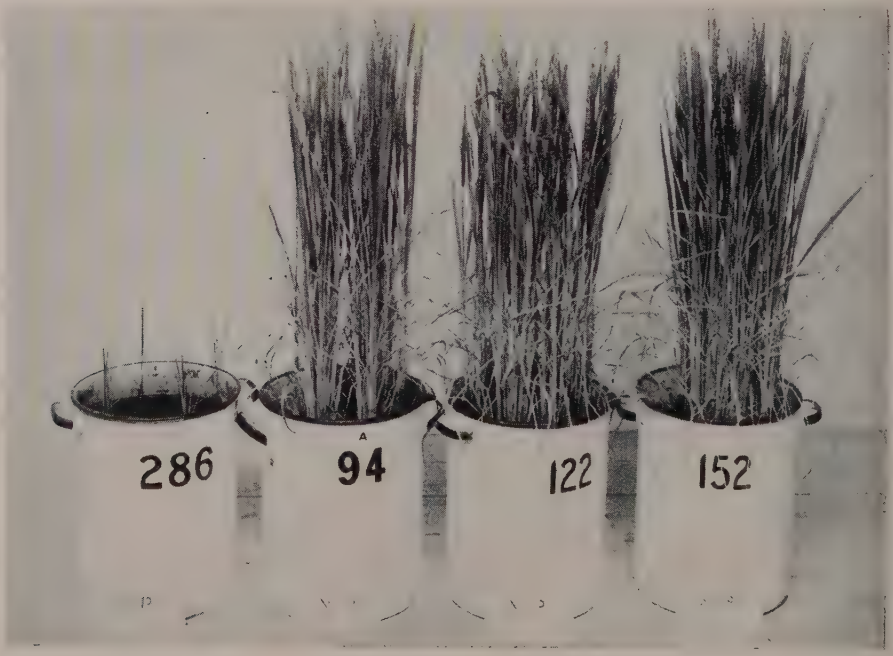


Treatment N_5P_0 Control N_3P_3 N_5P_3 N_5P_6 N_5P_{12}

(Photograph taken when plants were 50 days old)

PLATE IV

Effect of Applied Phosphate on the Growth of Padi



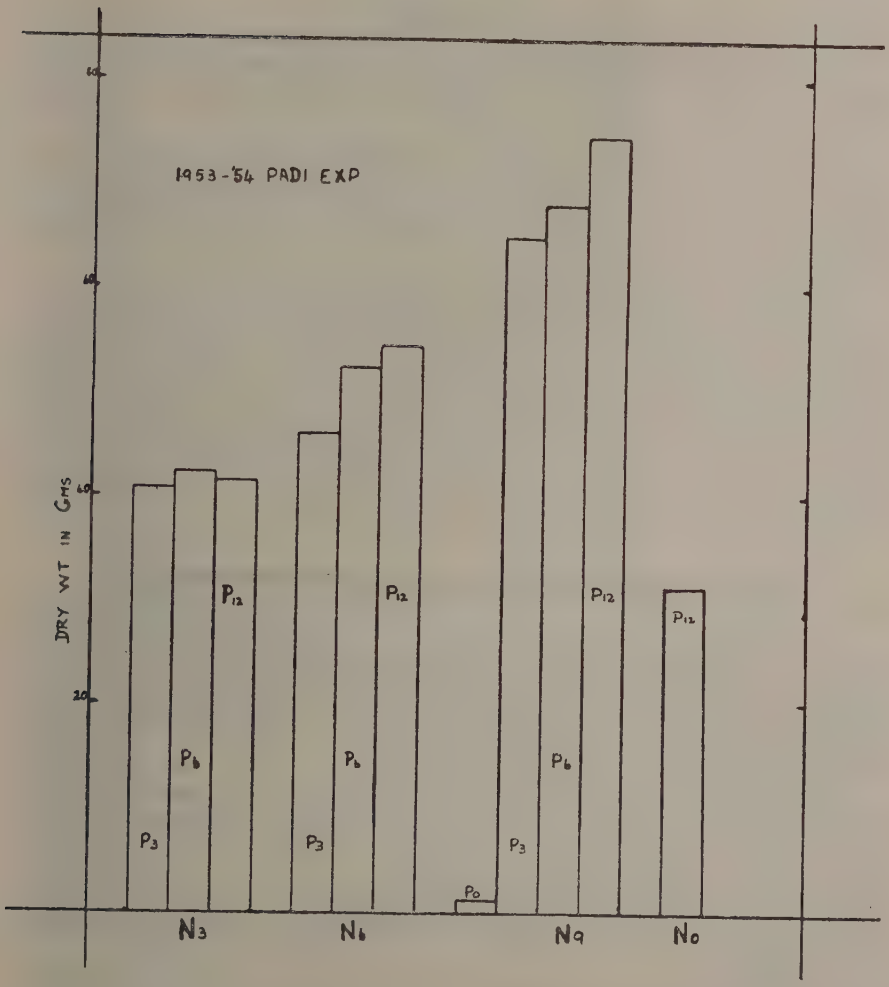
Treatment N_9P_0 N_9P_3 N_9P_6 N_9P_{12}

(Photograph taken two weeks before harvesting)

GRAPH I

Yield with Different Levels of Nitrogen and Phosphorus
(gm.)

(Padi Exp. 1953–54)



MASTER FARMERS OF MALAYA, I

BY

E. F. Allen,

Ag. Assistant Director, Field

Introduction

Ill-informed urban critics have often decried padi planters as lazy and thriftless men and tritely ask how they can expect a high return when they work for only six months in a year.

The Rice Committee's revelation that Malaya's average padi yield in recent years has been the highest in South-East Asia (2) has perhaps temporarily silenced such criticism, yet it provoked little enough public notice at the time.

It will perhaps come as a greater revelation that the best of Malaya's padi farmers are some of the most skilled and most successful in the world. Certainly there is much room for improvement in many of the less-favoured and smaller padi areas—and there always will be—but it is hoped that by publicizing the yields obtained by our finest padi planters and by giving details of the planting technique of such "Master Farmers" the rank and file amongst Malayan padi farmers will be encouraged to practise similar methods and so improve both their yields and incomes.

Padi Farming in the Tanjong Karang Irrigation Scheme

This irrigation scheme of some 50,000 acres lies on the north-west coastal plain of Selangor. Construction work by the Drainage and Irrigation Department commenced in 1939 and was largely completed by 1952 (4). Originally the land lay under swamp forest, but this was felled and cleared over a period of years between 1941 and 1948.

The area is level and water-control is generally good, especially in the developed blocks known as Sekinchang, Sungei Burong, Sawah Sempadan and Sungei Leman. Here, the soil—originally a shallow peat overlying clay—has now weathered down to a surface muck overlying organic clay. Farther east, the peat is too deep for padi cultivation and the land remains under swamp forest.

Padi is grown in the main season, from August to March, except in some of the peaty areas near the eastern boundary where the land is kept dry throughout the year in order to speed up oxidation and mineralization of the surface peat. Yields in the better areas are usually very high indeed and estimated yields for the 1956-57 season are given in Table I.

Table I

Padi Yields in Parts of the Tanjong Karang Irrigation Scheme, 1956—57

Locality	Yield of Padi (*gantangs* per acre)				Average Yield of Padi	
	Class A	Class B	Class C	Average	lb. per acre	kg. per hectare
Sekinchang	1,080	800	480	820	4,592	5,147
Sungei Burong	880	620	160	568	3,180	3,564
Sawah Sempadan	620	400	200	400	2,240	2,511

It will be seen later that the Champion Farmer of Sekinchang, Lum Teen, reaped 1,148 *gantangs* per acre of padi from his three-acre lot and later collected an additional 200 *gantangs* per acre from the regrowth. This total yield is equivalent to 7,549 lb. per acre or 8,461 kg. per hectare. In order to put this figure in its proper perspective it should be noted that the average padi yield in Japan is some 3,600 kg. per hectare (3) and it is well recognised that that country has the highest average in Asia. This yield of 1,348 *gantangs* per acre (168½ bushels per acre) represents a rice yield of over two tons per acre and compares very favourably with the highest known yields of wheat and maize.

It is particularly encouraging that Malay planters who practise similar methods elsewhere in the Tanjong Karang area also obtain yields in excess of 1,000 *gantangs* per acre.

Off-Season Cultivation in the Sekinchang Area

The more industrious and efficient farmers have always grown dry-land crops in the padi off-season and, in recent years, this practice has been encouraged by improvements of roads and paths in the district. At one time maize was almost the only crop grown; it is still the commonest crop but a wide range of vegetables and foodcrops are also cultivated. Usually the padi straw is burnt as soon after harvest as possible, leaving the land free from weeds. Maize is planted on the flat, but beds are made for such crops as chillies, brinjal, cucumber, long beans and tobacco.

Almost all the maize is harvested as green cobs for the fresh vegetable trade; the variety used is Yellow Flint. After harvest, the straw is cut down and allowed to remain as a dry mulch on the soil surface until it is burnt, shortly before the next padi season. Some agronomists will look askance at this practice of straw burning, but it is undoubtedly successful because it controls stem-borers, which attack both padi and maize, and also because there is no lack of organic matter in the soil. Manuring with inorganic fertilisers is practised to a modest degree only, since there is always the danger, on this rich soil, of over-lush growth early in the padi season.

All surface cultivation and weeding is very shallow indeed, and great care is taken not to bring unweathered clay to the surface. For this purpose, a special tool is used which is very like the traditional Malay slashing scythe or *tajak*, but the blade is much shorter and broader.

In the current off-season nearly 1,000 acres have been planted with off-season crops in Sekinchang. In addition, there are areas cultivated with long-term crops such as pineapples in the eastern peaty blocks. Some indication of the range of cultivation and the gross return per three-acre plot is given in Table II.

Table II

Details of Off-Season Cultivation in Sekinchang, 1957

Crop	Area (acres)	Yield per Acre	Price per Pikul ($)	Gross Return per Plot (3 acres)
Maize	500	5,000 cobs	(2½ ct. each)	$375
Colocasia	100	10 p.	10	300
Sweet potatoes	80	100 p.	10*	750—3,000
Tobacco	50	7—8 p.	80	1,800
Brinjal	50	175 p.	7	3,675
Chillies	30	170 p.	11—23**	5,610—11,730
Ginger	30	50—60 p.	22	3,630
Marrows	30	90 p.	16—18	4,590
Pumpkins	20	120 p.	4	1,440
Bitter Cucumber	20	80 p.	36	8,640
Lady's Finger	25	50 p.	9	1,350
Wax Gourd	10	120 p.	5	1,800
Tomatoes	10	35 p.	23	2,415
Miscellaneous	30	—	—	
Total	985			

* This price is exceptional due to the freak demand for this crop from influenza patients. $2.50 would be normal.

** The cheaper price is for green chillies; the higher one, for red.

Discussion

With intensive cropping it is not easy to estimate net returns even when the gross returns are known with some accuracy. Cash expenses in producing a crop are relatively modest except when hired labour is employed; land rent costs only $1 and water rate $4 or $6 per acre per annum. Seeds and insecticides have to be purchased,—also tools and sprayers. However, the fertiliser bill is unusually low for vegetable cultivation since the quantities used are very modest. One grower who works six acres in the off-season with his grown-up daughter and one hired man estimated his cost of growing chillies at about $1,000 per acre, excluding the value of his daughter's and his own labour. In general the crops with the highest gross returns are the most expensive to cultivate,—e.g. bitter cucumbers—or else they are susceptible to pests, disease and weather damage, like red chillies.

PLATE I

Off-season cropping in Sekinchang from the air.

PLATE II

Lum Teen, the Champion Padi Farmer of Sekinchang, is also a skilled maize farmer in the off-season. He is here discussing his crop with the Assistant Agricultural Officer.

PLATE III

Ching Sin Fah and his daughter grow three acres of chillies in the off-season. On another lot he also grows brinjals.

PLATE IV

Chan Ying grows cucumbers on his padi land and sells his crop to middle-men in Sekinchang Village.

PLATE V

Ching Sin Fah and Chang Ying discuss a neighbour's maize crop.

PLATE VI

Some farmers grow tobacco in the off-season. Yields are usually good, but the soil fertility is too high for good quality.

Undoubtedly these men make a good living, but they work long hours in the field and it should be remembered that the work involved in the original felling of swamp forest and gradual de-stumping was very arduous.

If the returns are then so rewarding, why—it may be asked—do more padi farmers not grow dry-land crops in the off-season? Certainly there is room for considerable expansion in the Tanjong Karang area itself as the good drainage and relatively good road communications now make marketing easier than formerly. Many Malay farmers also grow good crops of maize and field cucumbers, but the majority grow sufficient foodcrops only for their own needs and do not farm commercially. The basic reason for this is that they are satisfied with a lower standard of living than are the Chinese; whereas the Malay farmer is a self-contained unit his Chinese counterpart is essentially a commercial specialized grower of great skill and it is typical of him that he will not even eat his own rice, but insists on the best quality Siam No. 1 as his staple food.

The extension of off-season cultivation of dry-land crops in padi areas elsewhere in Malaya is, unfortunately, limited by climate, soil and economic factors (1). For instance, on the east coast, only intensive cultivation on a small scale is possible because the soils,—although often well-drained in the off-season—are relatively infertile and require the addition both of organic and inorganic manures. Moreover, the difficulty of pumping water to the surface is a factor which limits cultivation. The soils of the Kedah-Perlis plains are more fertile, but they dry out to intractable hard lumps after the padi harvest and wide and deep cracks develop. Furthermore, watering of off-season crops would be a major problem since the sub-soil water is often brackish. Farther south, in the rich padi land of north Krian, the soil remains swampy in the off-season and a vigorous growth of sedges develops; dry cultivation there is out of the question.

Nevertheless, there are areas in many parts of the country where off-season cultivation could be practised more extensively than at present, especially where the soil was once a shallow peat and has now weathered to a friable muck. Certainly such areas exist in parts of the Sungei Manik Irrigation Scheme and it is hoped that farmers there will strive to emulate the "Master Farmers" of the Selangor coast. Nothing succeeds like success and success is infectious when political aspirations open up new horizons to the padi farmer and show him the way to a higher standard of living.

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MASTER FARMERS OF TANJONG KARANG

BY

Ng Ngok Wah — *Assistant Agricultural Officer*
and
Mohamed bin Indot — *Cadet Agricultural Assistant*

LUM TEEN

Lum Teen, 54 years old, is a Kwongsai with Kheh influence who speaks a quaint dialect of combined Kwongsai and Kheh. Tall and hardy, he puts in about six-to-nine hours of regular field work each day throughout the year. This is about the maximum working period possible in Sekinchang, where planters live in a fenced-in New Village. Village gates open three times a day between 7 a.m. and 7 p.m. and are open for two hours each time for the planters to travel between home and their fields, which lie from just outside the fence to as far as 2½ miles away. Lum Teen's plot is about 1½ miles from the village, and he spends much time and energy in cycling between his house and his place of work. The bicycle is the common mode of transport in the padi fields.

Lum Teen's land had been cleared from swamp jungle in 1948. In accordance with the lay-out of the Irrigation Scheme the plot was marked out as a 3-acre lot measuring 3 × 10 chains.

The original occupant of the land cleared and cultivated part of the plot, adding a little at a time, but never utilised the whole of the three acres. The soil was shallow peat, fairly well drained, and full of tree stumps left from the initial jungle felling. Padi growth and yield were poor and returns were meagre. The occupant gave up the struggle and Lum Teen took over in 1949. He set about to clear and plant up the whole lot, while dealing with the tree stumps, slowly but relentlessly, until the whole area was cleared. Depressions and cavities left after removal of big stumps were filled with soil scraped from high ground, which in the process was levelled down.

In 1949 there was about a foot of peat on the land and the yield was about 700 *gantangs* of padi per acre; this was relatively low but the yields began to increase steadily, year after year, as the peat kept shrinking. It is interesting to note that Lum Teen did not deliberately burn off any peat, but left it alone to decompose and weather off by itself. Only padi stubble, weeds and the remains of dry land crops left after harvest were burnt.

To-day, only a trace of highly decomposed peat remains in the humus-rich loam lying over heavy clay. This is the soil which gives Lum Teen the phenomenal yields which in 1954 won him the prize for the highest yield in the Tanjong Karang Scheme, with a return of 1,062 *gantangs* per acre. In 1956, a systematically-manured portion of the land produced 1,190 *gantangs* per acre as against a yield of 1,180 *gantangs* per acre from unmanured land. The small increase from manuring speaks highly of the inherent fertility of the soil which, in turn, was brought to effective utilisation by the skill and

effort of its owner. It indicates that the land has now been brought to such a high level of productivity by correct farming technique and soil management that there is little left for added fertilisers to do.

In the 1956–57 season, the yield from Variety Serayap which Lum Teen planted was 1,148 *gantangs* per acre. At $13 per *pikul* for 172 *pikuls*, he obtained an estimated $2,236 for the season. In addition, he harvested 20 bags from the secondary regrowth, a yield which worked out at about 200 *gantangs* per acre. He is the Champion Farmer of Sekinchang (see Plate I). His off-season crops have all been maize. With the increased diversification of off-season crops in 1956, maize fetched him 4.2 cents per cob. Estimated yields of 7,500 cobs per acre gave him about $337 per acre or about $1,000 per lot.

Thus in the last year, Lum Teen's hard work and skill have brought him more than 1,300 *gantangs* of padi per acre and have made him one of Malaya's "Master Farmers".

ZAINI BIN HAJI MALEK

Zaini bin Haji Malek, a Malay of Arab and Banjar ancestry, was at one time in Krian working as a tenant padi planter, in which role he had to pay heavy tribute to the landlord. In 1946 Zaini left Krian and migrated to Tanjong Karang to start life anew.

His land was opened up from light swamp jungle in 1946. After the initial felling of big trees by Government, Zaini, like all other settlers, set about clearing the undergrowth and planting padi as space became available. The top soil was typical of the region—peat ranging from one-half to a little more than one foot in depth. The first year of pioneer planting yielded an estimated 50 *gantangs* per acre. In the second year, when clearing was nearing completion, the drainage and irrigation facilities had improved and some peat had been burnt or worn out; yields shot up quickly. By the third year clearing was complete and yields increased further to about 350 *gantangs* per acre. From then on, harvests improved steadily until in the 1956-57 season he obtained a calculated yield of 1,003 *gantangs* per acre.

Zaini owns one lot of 3 acres, but also works an additional one acre of the Drainage and Irrigation Department's bund reserve. He is shown in Plate II, at work on his land.

The interesting aspect of Zaini's plot is not his yield, however, as much as it is his land and the growing crop, which reflect the energy and skill he puts into his work. It is these that have made Zaini the Champion Padi Planter of the district and have given him the usual local fame going with the title. There is an annual competition of padi cultivation technique in the district, with prizes for the best lots for each of the seven localities of the district and a grand prize for the champion lot of all. Zaini has captured the first prizes for his locality, as well as the District Championship, for three years in succession. This year he has done it again!

One might like to know the "secret" by which Zaini achieved his success. Investigation reveals that his technique was no secret at all but ordinary, straightforward methods applied painstakingly and faithfully. Close

adherence to the planting programme, selection of seeds and seedlings, transplanting at the correct age, weeding of land during growth, maintenance of boundary bunds, control of rats and other pests, or—in short—*plain good husbandry* has been his key to success, a key available to every planter. It is only the degree to which good husbandry is followed that spells the difference between one man's crop and another's. And Zaini followed it to great lengths.

A noteworthy difference in Zaini's methods from those of his neighbours is in land preparation before planting. He clears and burns his weeds and other unwanted vegetation prior to irrigating the fields; this, he believes, improves growth and yield when compared with "wet weeding" where weeds are partially slashed and left to rot under water after the land is flooded.

He also adopts the use of the business-like *sabit* for harvesting in preference to the *tuai* which cuts the ears one at a time. Both these deviations from normal local practice are spreading in Tanjong Karang and this is all to the good.

Farmers everywhere are conservative and slow to adopt new methods, but the changeover from *tuai* to *sabit* here is a gratifying sign of progress.

Zaini plants the variety Radin Mengkudu which he chooses consistently every year because it is easier to thresh than other varieties.

In the off-season he plants cucumbers, pumpkins, maize and some chillies, for which no manuring is done. These crops bring him $300 to $400 each year, while a flock of about 200 head of poultry, fed on field gleanings, returns another $350.

Padi sold to the Chinese co-operative mills at Sekinchang fetched $12 to $13.30 per *pikul* last season, and last year's harvest of about 170 *pikuls* was sold for a little over $2,000.

Here is an example of a "Master Farmer" whose methods might well be copied and whose visible rewards should serve as an inspiration, especially to neighbouring farmers.

AHMAD BIN ABDUL HAMID

Ahmad, who owns a three-acre lot in Sungei Burong, came from Semanggol, Perak, and has been a farmer for the last eight years. Ahmad's land was originally opened up from peat swamp forest by his father. For the first few years yields were discouraging, but they increased steadily year after year as the peat decomposed. No burning whatsoever was carried out.

Ahmad's farming methods are the same as those of most of the other cultivators in the area. Cultivation is carried out by the use of the *tajak*, no buffaloes being used. The cultivation starts as soon as water arrives on the land, and when it is finished, the weeds and remains of dry land crops are collected and heaped at various points on the land. These heaps are

PLATE I

Lum Teen is the Champion Padi Farmer of Sekinchang. His yield of 1,348 *gantangs* per acre ranks with the world's highest from commercial farms.

PLATE II

Zaini bin Haji Malek has been the Champion Padi Farmer in Sungei Leman for four years in succession.

PLATE III

A fine padi crop grown by Ahmad bin Abdul Hamid, in Sungei Burong, almost hides his father, Abdul Hamid bin Manan.

then left for one month for decomposition to take place, after which the decomposed material is scattered evenly all over the land; transplanting takes place at least a week later.

Ahmad's yield for the 1955–56 season was 2,200 *gantangs* of padi from three acres. The 1956–57 season gave him 2,400 *gantangs*; he planted the variety Radin Puteh and used no manure. Part of his crop is shown in Plate III.

Ahmad keeps his land free from weeds and his bunds in good order. This, together with the use of poison bait, helps to protect his crop from rat damage. In the off-season he clears his land and grows maize. Ahmad thinks that planting off-season crops may be one reason for his high padi yields; undoubtedly, a very important reason for the higher returns from his land is that he is careful to follow *good farming methods* all the year round. Every farmer who wants to become one of Malaya's "Master Farmers" must do the same.

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK

JANUARY TO MARCH, 1957

Weather

The quarter has been exceedingly dry, particularly on the west coast from Malacca northwards and in East Johore. This has favoured the padi harvest, but the drought has been severe in Negri Sembilan and in the Kuala Selangor district.

Padi

A record harvest is reported from most areas, with low yields in certain inland districts of Kedah and in the late-planted portions of Province Wellesley.

Harvesting of experiments was completed or almost completed during the quarter in all parts of the country. The weather was ideal for this in Kedah and Perlis and was satisfactory in the other major padi-growing areas.

In Province Wellesley, Pahang and Johore, preparations for the off-season experimental plantings were begun in March.

RESEARCH

The short-medium term varieties Acheh Puteh and Tangkai Rotan have given 30 to 35 per cent higher yields than the standard short term variety, Radin Kling, at Kepala Batas in Kedah. Tangkai Rotan is likely to be preferred, as it gives a better quality rice.

Some of the new Serendah Kuning selections produced at Pulau Gadong, Malacca, promise to be of value in South Pahang; Serendah Kuning 29 has given a 58 per cent greater yield than the popular Pahang variety Seri Menjadi in a three year trial at Pahang Tua Padi Test Station.

Large increases in yield are unlikely to be obtained by variety selection in Kedah, but are expected to be of the order of 6 to 10 per cent. Significant increases in yield in this area will depend upon the development of hybrid varieties.

A comparison of yields of four pure lines of Radin Goi with mixtures of these lines in all combinations was carried out for two seasons to determine whether mixtures might prove to be less susceptible to seasonal variation and of wider adaptability than the pure lines. No differences were found.

Fourth to sixth generation hybrids between local varieties such as Siam 29, Nachin 11 and Radin China 4 have given yields of from 700 to more than 800 *gantangs* per acre at Telok Chengai, Kedah, in the past season.

Crosses between Serendah Menangkabau, Gaharu, Kuatek and Daron are producing varieties with very strong short straw which should prove useful for mechanical harvesting.

Yields of the introduced *indica* × *japonica* Cuttack hybrids are being steadily improved by selection. One cross between Pebifun and Nachin 57 gave a yield of 754 *gantangs* per acre in Kedah in the fifth generation.

In anticipation of early development of newly acquired land at Telok Chengai Padi Station, 59 new crosses have been made at Kuala Lumpur to combine high yield and good rice quality with strong straw and non-photosensitivity.

Though blast (*Piricularia oryzae*) is not usually a serious disease in Malaya, tests of all local varieties listed in the *F.A.O. World Catalogue of Genetic Stocks—Rice* have been carried out in connection with an investigation organised by the International Rice Commission. Wide differences in susceptibility were found; some varieties, e.g. Siam 29 and Milek Kuning, were almost completely killed whilst others, e.g. Padang Trengganu and Morak Sepilai Kechil, gave an immune reaction.

Recently completed experiments in which attempts were made to grow padi on peat in tanks have shown that an application of 3 cwt. of urea per acre six weeks after transplanting increased grain yield by 46 per cent, to 5,200 lb. per acre. Even larger increases (67 per cent) were obtained in pots to which one-third of this quantity of urea was applied. It was also found that shallow planting and growth in shallow water give better yields, the best being obtained with no free water above soil level. Deep planting and deep water resulted in poor root growth and poorest yields.

In tank cultures of padi on *gelam* soils, it was found that subsoil drainage increased yields by 90 per cent and with lime applied at the rate of 4 tons per acre in addition, yields were increased by 170 per cent. Without such drainage similar yield increases could be obtained by heavier lime dressings—up to 10 tons per acre.

An attempt to reproduce symptoms of *penyakit merah* involved soil treatment with sugar, sequestered iron and H_2S to induce reducing conditions, as well as artificial root damage. Although typical *penyakit merah* was not caused, the sugar, iron and root damage treatments caused severe stunting and low yield. The H_2S application did not reduce growth and yield but caused marked root proliferation, apparently as a reaction to early death of the older roots. The investigation is continuing.

Agronomic Investigations

A review was begun of the methods of conducting and reporting experiments on cultivators' fields. This form of experimentation has become increasingly important in recent years, and experience here and abroad suggested that modifications in techniques might be necessary. The advice of Dr. H. N. Mukerjee, Soil Fertility Expert, F.A.O., South East Asia, was of great value in this matter. Dr. Mukerjee visited Malaya at the end of the quarter.

Extension Work

All territories report gratifying results from manurial demonstrations which have mostly taken the form of two-plot blocks with only one plot manured. However, this particular technique will have to be abandoned in Kelantan where the very success of the demonstration has led to farmers applying fertiliser to the control plots also.

Twenty-nine manurial demonstrations on light soils in Padang Terap and Langkawi, in Kedah, gave an average yield increment of 932 lb. per acre of padi, which represented a net profit of $63, calculated on a padi price of 11¼ cents per pound or $15 per *picul*. Elsewhere in Kedah a top dressing of 30 lb. of nitrogen as urea led to yield increments ranging from 193 to 411 lb. per acre, equivalent to a net profit of $7.76 to $32.28.

Nursery manurial demonstrations continue to be very successful indeed in the Settlement of Penang. There were 31 demonstrations of this practice and yields from the 17 in Province Wellesley South showed an average response of 640 lb. per acre of padi. Since the fertiliser costs only $1.60 per planted acre the practice is highly economic.

The use of progressive wet-padi farmers in Trengganu for extension purposes has proved to be highly efficient. The system depends on selecting outstanding farmers in each district who are prepared to accept and follow the advice of the Department of Agriculture at every stage of padi cultivation. In return, they receive sufficient free seed and fertilisers for two acres of their land. Six of these farmers obtained yields ranging from 450 to 810 *gantangs* per acre; they had obtained only 200 to 400 *gantangs* per acre in the previous season.

In one particular case in the Besut district a progressive farmer's land was completely submerged for five days during the November floods. Eventually he obtained a yield of 230 *gantangs* per acre, whereas his neighbours reaped only 120 *gantangs* per acre. This superior yield was achieved by following the correct planting dates and the use of fertilisers which helped to overcome the flood damage.

In the Tanjong Karang area of Selangor harvesting was half completed by the end of the quarter. Excellent yields of 816 and 700 *gantangs* per acre have been reported from the Sekinchang and Sungei Leman areas, respectively. The bulk of the crop has been sold to the Co-operative Rice Mill at Tanjong Karang in spite of the issue of purchasing licences to Kuala Lumpur rice millers.

In Kelantan, where a fertiliser subsidy was in force for the 1956-57 season, a total of 920 tons of padi fertiliser was sold to farmers, of which 102½ tons were sold at the unsubsidised price.

During the recent harvest a sustained effort has been made in Kelantan to popularise the use of the sickle and the threshing tub (*tong banting*). Twenty-eight of these tubs were made by the Department of Agriculture and loaned out to farmers free of charge. This innovation has been received enthusiastically and many farmers have made their own equipment. Since the technique gives a large heap of straw instead of leaving a long stubble in the field, it is an essential step in the direction of straw utilisation for fodder and bedding.

Dry padi crops have been highly variable, with low yields reported from drought-affected areas of Negri Sembilan and the Kelantan plain. However, upland dry padi in Kelantan gave the very high yield of 300 *gantangs* per

acre and it is most encouraging to note that this was almost all catch-cropped in young rubber areas and did not depend on the usual shifting cultivation.

In Kedah the traditional practice of applying phosphatic bat guano is now wide-spread; the application rate is about 100 *gantangs* per acre, which is equivalent to at least 120 lb. per acre of P_2O_5 (52 lb. P per acre). The cost of the guano has varied from $75 to $125 per 1,000 *gantangs* depending on the distance which the fertiliser is transported from the guano caves. Production from four caves in Kodiang has amounted to 670,000 *gantangs*.

There are now 35,624 registered members of 219 branches of Padi Planters Associations in Kedah. During the quarter a sum of $207,812 from the funds of the Padi Planters Board has been spent on redeeming mortgages (*jual janji*) and usufructuary loans (*gadaian*). This has benefited 127 farmers by the redemption of 550 acres of padi land.

Rubber

During the quarter the following quantities of improved planting material have been distributed to small growers:-

	Budwood (yd.)	Clonal Rubber Stumps
For new-planting	10,353	276,730
For replanting	18,024	338,531
Total	28,377	615,261

In addition 12,000 surplus stumps have been despatched to Sarawak and 19,806 yd. of over-age budwood have been destroyed.

A total of 5,546,778 Tj.1 selfed clonal seed were purchased during the quarter and distributed to nurseries. This brings the total for the season to 18.6 million seeds.

Departmental and contract clonal seedling nurseries are mostly in good condition, but it is evident that supplies will be somewhat short of requirements during the coming planting season. The deficit will have to be made up by budwood, of which good supplies are available.

Prices have been reasonably stable during the quarter with good quality smoked sheet selling at $90 to $105 per pikul. It is reported that these good prices have encouraged the use of latex stimulant by Johore smallholders. In general, however, yields have been seasonably low because of wintering.

There is keen interest in new-planting in many areas. Land is being approved on a large scale for this purpose in Trengganu but unfortunately not in blocks except in Kemaman. In Johore some 1,500 acres have been cleared at Bukit Serampang and near Tangkak; of this, 300 acres have already been planted.

At Pontian, Johore, two areas zoned for rubber development have not yet been alienated, but some illegal clearing has commenced already. Similarly, at Batu Pahat where alienation of a 2,000 acre block has not yet commenced, more than half of the block has already been cleared.

Satisfactory progress is reported from rubber pilot schemes in North Kedah where clearing, burning, lining, and holing have been carried out in preparation for May planting.

Latex sales by smallholders to commercial and co-operative factories have been satisfactory.

Cacao

A satifactory technique has been worked out for laboratory scale production of chocolate from dark bean cacaos (Trinitario and Amelonado) and the high quality light bean Criollo types are now being tested, as they are reputed to require a shorter fermentation period. Drying tests are being carried out on fermented beans in order to determine the most suitable type of drying equipment for commercial use in this country.

Both pulasan and rambutan seeds can be fermented and processed to produce a product very similar to chocolate. Samples have been prepared and sent abroad for appraisal.

Certain abnormalities in the growth of cacao at the Federal Experiment Station, Jerangau, were observed during 1956; these were more prevalent towards the end of the year than earlier. The symptoms were marginal leaf scorch, leaf mottling, yellowing and bronzing, and shoot die-back.

Similar die-back of shoots, accompanied by leaf chlorosis, has been found on cacao on the Federal Experiment Station, Serdang.

It is considered that these symptoms probably arise from soil nutrient deficiencies; these in turn may accentuate the effects of damage by pests and minor fungal diseases.

Analyses of affected and healthy leaves from Serdang showed that the calcium and manganese contents were low and the potassium content was high in the chlorotic leaves. Field surveys of the nature and circumstances of occurrence of the symptoms are being carried out.

A general improvement in growth was observed at the Federal Experiment Station, Jerangau, towards the end of the monsoonal rains, when the usual seasonal vegetative flush began; 1,694 pods were harvested from seed gardens—a higher yield than in the same period of 1956. Fermentation trials were continued.

Desmodium ovalifolium grew vigorously in cacao fields at the Federal Experiment Station, Serdang, and showed considerable promise as a ground cover for young cacao areas.

There has been a keen demand for cacao planting material from the two Trengganu estates, where commercial planting is still in progress.

In the Jerangau Pilot Scheme some damage to the young plants was caused by *kijang*,* which have since been shot. Nurseries for the remaining 30 acres in this scheme have been prepared and 21,500 baskets have been treated with a copper-naphthenate preservative. The daily grant paid to participants in this scheme was increased to $2 from the beginning of the year.

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* kijang = barking deer.

Excellent growth of cacao continues to be recorded from Lower Perak where the crop has been planted under mature coconut palms. A further 20 acres have been planted during the quarter.

Coconuts

The young palms planted at the Federal Experiment Station, Telok Bahru, late in 1956 and early in 1957 suffered considerably as a result of the abnormally dry weather during most of the quarter. However, this weather permitted good progress in drainage and *lalang** eradication on a further 35 acres of land at the same station.

In the manurial experiment on smallholders' land in Trengganu yields of nuts continued to reflect the beneficial effects of manuring; numbers of nuts harvested for the quarter were as follows:-

Manured with 14 lb. of NPK mixture per palm per annum	Manured with 7 lb. of NPK mixture per palm per annum	No manure
2,032	1,796	837

In West Johore 46 acres have been new-planted, 11 acres replanted and the equivalent of 7 acres supplied. At Ulu Senggarang 200 acres of recently planted palms have shown excellent growth.

More attention is now being paid to maintenance work as drainage improves in West Johore. Intercropping with bananas is popular and also with *keladi*,† brinjal, tapioca and coffee.

Experience on Bagan Datoh estates with trial replantings shows clearly the necessity for manuring even on this rich deltaic alluvium. Clean clearing leads to much better growth than under planting.

Oil Palm

In an experiment being carried out on an estate in Selangor, various crosses of the Dumpy palm are producing yields of up to 1.4 tons of oil per acre at 5½ years of age. Crosses between pairs of the three palms No.12/3, 14/2 and 1/7 are giving particularly high numbers of large bunches. Heavy yields are also being obtained from experimental tall palms at Jerangau in Trengganu which have produced up to ¾ ton of oil per acre at 4⅓ years of age.

Pineapple

Tests in the field have confirmed that *Erwinia carotovora* is the causative agent of pineapple fruit collapse; in both field and laboratory tests the disease was easily reproduced and its development and final symptoms were the same.

A survey of fruit entering canneries in Johore and Singapore has shown that serious fruitlet brown rot occurred in only about 5 per cent of the fruit, though minor infection, insufficient to cause loss of processable material, was present in 39 per cent.

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* *lalang* = *Imperata cylindrica.*
† *keladi* = *Colocasia esculenta.*

Mulching appeared to benefit growth in a trial at the Federal Experiment Station, Jalan Kebun. In Kelantan, growth in a manurial experiment was outstandingly good; the trial is sited on the very poor soils north of the Deficiency Area in Pasir Mas District.

In Perak 400 acres of canning pineapples were planted by an estate and 123 acres by small-holders.

Labour disputes in Johore canneries have led to lower standards of maintenance on some estates and small-holdings and purchases of fertiliser have declined.

Co-operative marketing societies have done good work in Johore in spite of an acute shortage of road transport. Nearly $100,000 worth of fruit have been sold through these societies.

A high standard of maintenance is reported from small-holdings in the Parit Selangor and Jeram Batu areas of Johore. Elsewhere, demonstrations of manuring and of good cultivation have aroused interest in spite of lower prices for fruit.

Other Fruits

Satisfactory progress was made in the development of central budwood nurseries at the Federal Experiment Station, Serdang. These nurseries are intended to provide proven clonal budwood for the extension of nurseries in the States and Settlements.

Work continued in the establishment of citrus root-stock trials at the Federal Experiment Stations, Gajah Mati and Serdang.

A total of 9,533 clonal fruit trees have been distributed during the quarter, as well as 305 fruit tree seedlings.

The price of Mandarin oranges fell to $20 per pikul because of large imports for Chinese New Year. Orchards in Lower Perak are suffering severe damage from gummosis but an extra 67 acres have been planted in Perak North.

Tea

Clonal selections were brought into plucking at the Federal Experiment Station, Serdang. Propagation of clones continued.

Increases in the nitrogenous part of the standard manurial mixture applied to non-experimental areas were followed by a very substantial increase in yield at the Federal Experiment Station, Cameron Highlands. An interim review of a manurial trial at this station confirms that manuring with a nitrogen-phosphate mixture (381 lb. sulphate of ammonia and 81 lb. Christmas Island rock phosphate per acre per annum) results in highly profitable yield increases in the Highlands. The need for and value of potash have not been established as yet, but it is thought that a small dressing may be a useful long term insurance measure.

Coffee

During the quarter the Selangor price of Liberian beans fell by $10, to between $134 and $140 per *pikul*. Nevertheless, interest in planting this crop has been reported from the Sri Menanti and Batu Pahat areas of West Johore.

In Negri Sembilan 45 acres of smallholders' coffee planted on old rubber land has continued to make satisfactory growth.

Tobacco

There has been no decreased planting in Kelantan as a result of the excise duty, for most growers process and retail their own leaf and the produce of such cottage industries is not dutiable.

Pasture, Fodder and Livestock

Several meetings and tours were arranged for the visit to Malaya of Dr. Oliver West, an F.A.O. expert on pastures. Dr. West was impressed by the pasturage potentialities in Malaya; his advice was of very great value to the officers of the Department who are concerned with work in this field.

Multiplication beds were planted with six East African varieties of Guinea grass (*Panicum maximum*) in preparation for experimental comparison of these varieties with the local type.

An investigation of the rations fed by certain commercial pig rearers in Penang and Province Wellesley led to an interim conclusion that the calcium and phosphate contents of rations fed to pregnant and suckling sows were very considerably below the levels considered satisfactory in other countries. It was thought that this might possibly be one of the reasons for the poor breeding performance of cross-bred female pigs in the area concerned.

An observation at the Federal Experiment Station, Serdang, showed that stall-fed, mature Bali cattle would consume 80 to 100 lb. of freshly cut fodder grass per day and would increase in live weight by about 1¼ lb. per day. This rate of increase is markedly superior to that of the local Kedah-Kelantan type of animal.

Good progress has been made in the extension of mixed farming techniques in Kelantan by popularising stall feeding of cattle using padi straw as bedding and bulky fodder. Plots of stylo provide green fodder and the storage of padi straw is facilitated by the use of a Departmental baler.

A special baling course for operators was held at Paya Besar, Kuantan, during February using straw from a mechanically harvested crop of dry padi.

Soil Surveys

Detailed mapping of the boundaries of soil types in the padi areas of Kedah was resumed in February and mapping of 50,000 acres has been completed so far. The boundaries are accurate to within 200 yards.

Three areas in Kedah under consideration for development schemes were also surveyed. Soils in the vicinity of Jitra and Pokok Sena were very poor, but fairly good soils were found in the Kampong Titi Akar area some 20 miles south-east of Alor Star. A similar survey of the Solok Menggong area of Malacca showed the soils to be poor but suitable for such crops as rubber.

Canning Research

Canning research during the quarter has been mainly related to preparation of concentrated pineapple juice. First batches have been unsatisfactory owing to darkening in colour and development of an off-flavour in storage. Steps are being taken to remedy this, but work is being held up owing to strikes at canneries.

Satisfactory pineapple jam has been prepared by adding guava juice to pineapple crush to make the jam set.

Education

Eight courses of 12 to 21 days duration for 128 students have been conducted at Cheras, Selangor, and Ayer Hitam, Johore.

In Perak Central a travelling Agricultural Advisory Service lorry has made nine tours of rural areas, during which 6,300 instructional leaflets were distributed and 503 budded fruit trees sold.

MECHANISATION

Half-Yearly Report, October, 1956, to March, 1957

Compiled by the Agricultural Engineer

Investigations into the Cultivation of Wet Padi

Mole Ploughing

A simple mole plough was constructed for a drainage experiment on *gelam* padi soils in Malacca. The main beam was a simple sledge and the vertical knife was pivoted to the rear of the frame in such a way that its pitch could be adjusted by a telescopic link; the mole was four inches in diameter and the normal working depth was 24 inches. The mole plough was winched across the fields by a Fishliegh winch mounted on very large Athey tracks. The large sprag was lifted by hydraulic cylinders connected to the hydraulic pump of the Ferguson tractor, which powered and towed the winch.

During field trials the mole plough was found to be more satisfactory than the commercial implement, with wheel-operated self-lift, which had been used in previous seasons. The depth was readily controllable and lifting the implement out of work caused no difficulty, since the whole device would leap into the air when the telescopic link was released and the knife allowed to swing back.

The main difficulty of mole draining, the presence of sunken timbers, was not overcome, however. If the mole is forced through a timber, the soil around the timber is disturbed and the channel soon collapses; if the mole plough is lifted out and started again on the other side of the obstruction, the drain is useless.

Harvesting

Padi threshing trials were conducted at Pulau Gadong, Malacca, by an officer of the National Institute of Agricultural Engineering. Five specially-designed threshing mechanisms were tested under various conditions and promising results were obtained from some of the units.

Investigations into the Cultivation of Dry Padi

Harvesting

The dry padi at Paya Besar, East Pahang, was again harvested mechanically. The Bissett binder and Rajah thresher were again used, but the sheaves of padi were carted to the thresher by a Ferguson tractor and trailer. Owing to the late arrival of the binder, which had been required at the Trans-Perak Pilot Scheme, some of the crop had to be cut with a normal Ferguson mower; although the cut material could be handled quite easily with pitch forks, there was considerable wasteage due to shattering.

All of the straw was baled with an Opperman light weight baler and very high outputs of bales were obtained. A one-week course for baler operators from five states was held at Paya Besar during the harvest.

Trans-Perak Mechanisation Farm

The wet padi crop suffered a very serious set-back because the irrigation supply was a month late; the supply was erratic throughout the season and it was difficult to control weeds. More than half of the wet padi had to be abandoned and the yield from the remainder was only 185 *gantangs** per acre, although five 0.001 acre bird-proof cages yielded an average of 471 *gantangs* per acre.

The control of *Mimosa* presented great difficulties in the dry padi areas; it was particularly troublesome where early lodging occurred. Rat and bird damage was extremely severe and the average yield of the dry padi crops was only 93 *gantangs* per acre, although the yields from the birdproof cages were good, averaging over 300 *gantangs* per acre.

Conditions during the harvest were poor, owing to the unevenness of the crop due to lack of water, pest damage and the prevalence of *Mimosa*.

Work is now in progress on a high level distributory system which, with the 4.2 cu.sec. tractor-driven pump which has now been purchased, should enable the majority of the 100 acres of padi land to be irrigated.

The stubble has been cultivated to encourage germination of weed seeds and an intensive land cleaning programme has been planned. Poison baits are being laid in an attempt to reduce the rat population during the off-season and the possibility of a widespread pest destruction campaign is being investigated.

Tests and Modifications

Demonstration of David Brown Tractor

A demonstration of the David Brown 900 and 2D tractors was given at Serdang by the local agents.

The 900 model was fitted with a rotary brush cutter and performed exceptionally well in very heavy *belukar** under abandoned oil palms. The tractor was not fitted with a bumper-bar or guard, but it pushed over very large bushes without any difficulty and the brush cutter reduced the debris to a satisfactory mulch.

The 2D is a very specialized type of tractor which may not find many applications in Malaya. It was used at Serdang for the inter-row cultivation of fodder grasses, a job for which it is well suited. The driver has an excellent view of the mid-mounted tools and the manoeuvrability of the tractor is very good.

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* 1 *gantang* = 1 gallon.
* *belukar* = young jungle.

Review

PADI LANDSCAPES OF MALAYA

By E. H. G. Dobby, Ph.D., and others. The Malayan Journal of Tropical Geography, Vol. 6, October, 1955. Dept. of Geography, Univ. of Malaya, Singapore. Price Malayan $3.50 or 8s. 6d.

In 1955, the Department of Geography, University of Malaya, conducted field surveys in three areas of north-west Malaya "to obtain basic material upon which government agencies might with greater confidence frame their policies" with regard to padi farmers. The surveys were directed by Professor E. G. H. Dobby, who also contributes a general article reprinted from 1952.

The three surveys are called "micro-geographical studies" but might more accurately be described as macro-studies since they coverd 9,213, 5,792 and 1,539 acres in Perak, Kedah and Province Wellesley, respectively. The areas are arbitrarily defined; two fall within *mukim* boundaries and the third is bounded by a triangle of roads. Professor Dobby wishes the areas "to be taken as samples" (p.7), though this is obviously in the non-technical sense of the term, since the results are not subject to statistical evaluation.

The surveys are an interesting application of the mapping technique of the geographer to economic data. The article contains 56 pages of well produced map-plates and these present the findings of the survey teams, supported by 78 pages of written report, approximately half of which give a general introduction to each area largely based on data made available by Government Departments (e.g., health, soils, climate, agricultural methods, etc.).

The original data obtained by the survey teams are intended to cover the whole of the padi land comprised within the respective *mukim* or triangle, as listed by surveyed lots in the Land Office Registers. The lots were then visited and a questionnaire completed for each household found within the selected lots. The data were put on to a series of cadastral map sheets showing these surveyed lots.

It is doubtful whether this method of enquiry can fully secure the data sought. The method assumes that farmers resident inside the survey area do not cultivate land outside, and that no farmer resident outside the area cultivates land inside. The situation is never as simple as this in areas such as those chosen, with boundaries large in proportion to their areas, especially the Krian road-bounded triangle. There must be some farmers whose surveyed "farms" are smaller than their actual farms, and also there must be some padi land inside the area for which no corresponding farmer is recorded. No explanation is given as to how this "border-problem" was solved.

The procedure for mapping data requires that there be no ambiguity of the area to which the map refers, and it is normally easy to avoid missing or overlapping information of a geographical and physical nature. But the mapping of economic data requires careful definition of the units which are being mapped.

No definition is, however, given of a "padi farm" or a "padi holding" and the maps reveal that analysis was by surveyed lot, each lot being considered as a "small-holding". The survey therefore is based on the assumption that only one farmer cultivates on each lot and that he cultivates on one lot only; in other words, it implies that there is no fragmentation of padi lots. This assumption has been proved untrue in every survey in Malaya, even in the Lower Perak Scheme with padi farms less than 20 years old. In the three areas described in the article, the land had been cultivated for at least 50 years. Fragmentation is not mentioned at all in the Province Wellesley area, is mentioned only for the large lots in Kedah, and for only 39 out of the 2,106 lots in the Krian triangle. The report is limited by the omission of the appropriate questions from the questionnaire.

It is, therefore, rather misleading to put data obtained from farmers into maps representing lots. There is no value in mapping the number of fowls per lot (Plate 49) when the area of padi cultivated by one farmer (the true "padi farm") does not coincide with the lot. Much of the resulting analysis is consequently invalid. The "correlation between the number of fowls on the lot and the areas of highest yields of padi" (p.73) is not logically possible.

The chapters "Land and Landowners" for each survey area are subject to the same criticism: it is not possible to map tenancy situations in old Malayan padi lands in patterns of complete lots. This leads to mapping contradictions: some lots in Krian are shown as owner-worked on one map (Plate 55) and as rented on another (Plate 57). Similarly, Plates 13 and 14 (Province Wellesley) and 31 and 33 (Kedah) are inconsistent.

Professor Dobby divides farmers into "owners" and "tenants" only and omits the very important class of farmers who own part and rent part of the land they cultivate, i.e. the "tenant-owners".

The average size of padi farm (the area cultivated as an economic unit by one farmer) is nowhere mentioned, though it is calculable from the article itself. The total of 8,249 padi acres in Krian (p.68) divided by the total number of 1,300 padi farming households (p.78) gives an average of 6.3 acres per farm, somewhat larger than the average size of 4.5 acres per lot (p.78). The average size of tenant farm by the same method is 1.66 acres. The true padi farm is therefore very different from the surveyed lot which is the unit for mapping.

The statement "Twenty-two persons in the triangle own more than 10 acres, but in no case is the total acreage owned by one person reported to be as much as 20 acres" (p.78) is contradicted by the figures on the same page which give an average of 24 acres per owner-worked farm (i.e. 6,546 owner-worked acres divided by 273 owner-farmers.). These figures are obviously unacceptable and result from the original failure to define the padi farm and to follow one definition consistently through the collection, analysis and mapping of this information.

The basic problem of agricultural indebtedness is mentioned briefly, but no estimate is made of the numbers of farmers or the amount of credit involved. The relationships of indebtedness to land tenure, general purchases and the marketing of padi are not discussed.

The article, however, describes a survey of some interest and a technique of analysis which is obviously still experimental. It is a commendable attempt, which almost succeeded, to extend the scope of "micro-geography". The small but fundamental problems of definition of the economic units under study, which resulted in the distortion of much of the basic information obtained, should be successfully solved in future surveys by co-operation with the Department of Economics, at least in the initial planning stages. It is to be hoped that the University will continue this type of research, which is so important to the rural development of Malaya.

T. B. W.

Staff Notes

Honours and Awards

His Highness the Sultan of Selangor was pleased to confer the Selangor Meritorious Service Medal on Che Zakaria bin Abdul Raof, Assistant Agricultural Officer, Selangor, on the 3rd June, 1957.

It was announced in the Queen's Birthday Honours List, 1957, that Her Majesty had been pleased to appoint Che Zakaria bin Abdul Raof, Assistant Agricultural Officer, Selangor, to be an Honorary Member of the Most Excellent Order of the British Empire.

Promotions

Mr. J. K. Coulter, Senior Research Officer, Grade B, was promoted to Senior Research Officer, Grade A, with effect from the 14th January, 1956.

Appointments

Mr. K. Sithamparapillai, General Clerical Service, was appointed to the post of Office Assistant, with effect from the 15th May, 1957.

Mr. V. Sundram, Financial Assistant, was appointed to act as Administrative Officer with effect from the 21st April, 1957.

Transfers

Mr. J. R. Dunsmore, Agronomist, from the post of Agronomist (Selangor) to that of Agronomist-in-Charge, Federal Experiment Station, Serdang, with effect from the 2nd April, 1957.

Mr. P. Class, Agricultural Officer, from the post of State Agricultural Officer, Negri Sembilan, to act as State Agricultural Officer, Pahang, with effect from the 3rd April, 1957.

Mr. J. S. Ure, Agronomist, from the post of Agronomist-in-Charge, Federal Experiment Station, Serdang, to Settlement Agricultural Officer, Malacca, with effect from the 8th April, 1957.

Mr. N. Kanagaratnam, from the post of Agricultural Development Officer (Cameron Highlands) to that of Agricultural Development Officer (Serdang), with effect from the 15th April, 1957.

Mr. G. S. Keeping, Agricultural Officer, from the post of State Agricultural Officer, Pahang, to act as State Agricultural Officer, Johore, with effect from the 16th April, 1957.

Mr. T. R. Dickinson, Agricultural Officer, from the post of Settlement Agricultural Officer, Malacca, to act as State Agricultural Officer, Perak, with effect from the 16th April, 1957.

Che Mohamad bin Jamil, Agronomist, from the post of Agronomist (Headquarters), to that of State Agricultural Officer, Trengganu, with effect from the 29th May, 1957.

Che Mohd. Arif bin Abdul Rahman, from the post of Assistant Agricultural Officer, Perlis, to that of Assistant Lecturer, College of Agriculture, Serdang, with effect from the 1st June, 1957.

Che Mohd. Noor bin Wahab, Agricultural Officer, from the post of Agricultural Officer, Selangor Coast (North), to that of Agricultural Officer, Perlis, with effect from the 1st June, 1957.

Mr. J. L. B. Hitchcock, Agricultural Officer, from the post of State Agricultural Officer, Trengganu, to act as State Agricultural Officer, Kelantan, with effect from the 6th June, 1957.

Mr. Chew Hong Jung, Plant Breeder, from the post of Botanist, Federal Experiment Station, Pulau Gadong, Malacca, to that of Senior Lecturer, College of Agriculture, Serdang, with effect from the 13th April until the 10th June, 1957. He assumed duty as acting Principal, College of Agriculture, Serdang, with effect from the 11th June, 1957.

Leave

The following officers have proceeded on leave:-

A. V. Haddon, Plant Breeder, on the 4th March, 1957.

A. Johnston, Plant Pathologist, on the 30th March, 1957.

H. M. James, Senior Agricultural Officer, Grade A, on leave prior to retirement, on the 16th April, 1957.

S. J. Navaratnam, Plant Pathologist, on no-pay leave to undertake post-graduate study in Australia, on the 16th April, 1957.

W. N. Scott, Senior Agricultural Officer, Grade A, on leave prior to retirement, on the 18th April, 1957.

A. Cumming, Agricultural Development Officer, on the 21st April, 1957.

H. F. Logan, Administrative Officer, on the 21st April, 1957.

M. J. Strickland, Agronomist, on leave prior to retirement, from the 31st May, 1957.

J. J. Holmes, Publications Officer, on leave prior to retirement, on the 3rd June, 1957.

H. Ritchings, Horticultural Officer, on leave prior to retirement, on the 3rd June, 1957.

T. B. Wilson, Agricultural Economist, on the 4th June, 1957.

P. G. Coleman, Senior Agricultural Officer, Grade A, on the 5th June, 1957.

O. M. Lee, Principal, College of Agriculture, Serdang, on leave prior to retirement, on the 10th June, 1957.

Notes on Retiring Officers

Mr. H. K. Ashby

Mr. Ashby, who has a long record of service, first joined the Department in 1934 and served for nearly 10 years in Kelantan and Trengganu, two States on the agriculture of which he became an authority. The remainder of his service was in Johore as State Agricultural Officer and for shorter periods in his younger days in Perak, Cameron Highlands, Singapore and Negri Sembilan. He was Ag. Assistant Director (Field) before going to the United Kingdom on leave prior to retirement.

He possessed a keen enquiring turn-of-mind and as a result his investigational work was always of a very high standard. One could always rely upon him to be strictly and at times almost too orthodox in his approach to rural problems.

With his departure the Department has lost a most valuable and experienced officer.

Mr. A. E. Billington

Mr. Billington joined the Department as Canning Officer in May, 1950, and was in charge of food processing research at the Canning Research Station in Johore until April, 1954, when he was transferred to Headquarters to take over the duties of Senior Chemist. He acted as Assistant Director (Research) for six months in 1956 and retired from the post of Senior Chemist in July, 1957.

As a keen sportsman and an accomplished musician his interests covered a wide field. His extensive knowledge and experience of agricultural and food chemistry and his capacity to get things done with a minimum of fuss are a loss the Department can ill-afford.

Mr. P. A. Gething

Mr. Gething joined the Department in 1951 after a period of service in Nigeria; he served in this country as State Agricultural Officer in Negri Sembilan, Pahang and Selangor. He was a quiet, unassuming worker who got things done and who had the rare gift of imparting his own good humour to his colleagues. Altogether, he was one of the best balanced members of the staff and his loss is a serious one.

Mr. J. J. Holmes

Mr. Holmes, who joined the Department in 1947 as Assistant to the Agricultural Economist, took over the post of Publications Officer in 1952. To him fell the task of editing the *Malayan Agricultural Journal* and preparing for publication all leaflets, bulletins and other publications of the Department of Agriculture.

He served the Department well and those officers with whom he came into contact always found him most co-operative and congenial in his work. He relinquished duty in June, 1957, to go on leave prior to retirement.

Mr. H. M. James, M.C.

Mr. James joined the Department in 1946 with a distinguished war record and having served pre-war as an Agricultural Officer in Cyprus.

His service in Malaya was varied; it ranged from Agronomist, Federal Experiment Station, Serdang, Ag. Principal of the College of Agriculture, Personal Assistant to the Director, and Settlement Agricultural Officer, Malacca, to State Agricultural Officer, Pahang, and State Agricultural Officer, Johore.

His longest tour of duty was as State Agricultural Officer, Pahang, during a most difficult period of the emergency. During this time he was given full scope to show how the skill of the agriculturist can be combined with that of the soldier; he succeeded in doing both jobs well.

'Jimmy', as he was known to the Department, possessed a vast sense of dry humour and the knack of 'suffering fools gladly'.

Mr. and Mrs. O. M. Lee

Mr. Lee first joined the Department in 1945 after release from the British Army. The whole of his career was spent at Serdang, mainly at the College of Agriculture. He became Principal in 1949 on the retirement of Mr. V. Dawson.

In 1948 the senior staff of the College was considerably strengthened by the recruitment of his wife. Together the Lees carried the College through the very difficult post-war years and their patience and conscientious efforts will long be remembered by the new generation of agriculturists in Malaya.

Probably the greatest tribute to their work can be seen in the large number of graduates of the College of Agriculture who are now either undergoing further training overseas or working in the Department of Agriculture.

Dr. W. N. Scott

Dr. Scott joined the Department in 1938 and served as an Agricultural Officer in Perak and Johore and later as State Agricultural Officer in Perak, Johore and Negri Sembilan. He also acted as Principal of the College of Agriculture for a short period.

Academically, he was very highly qualified. He was a congenial colleague, with something of the absent-minded professor about him which, when combined with a contempt of routine administration as an end in itself, developed into an often exasperating habit of mislaying inconvenient files. He would probably have been better placed in the Education Branch of the Department.

January to March, 1957

Rubber.—The average of the noon prices paid for R.S.S. No. 1 (f.o.b. in bales, buyer) in Singapore declined gradually from the high of the 1st January, which was 112.875 cents per pound, until on the 23rd of that month the price stood at 90.125 cents per pound. There was a slight recovery up to the 30th January when the price was 93.125 cents per pound.

The February prices varied between 85 and 90 cents per pound.

In March the prices of R.S.S. 1 varied from 88.50 to 95.00; the average price for the month was 91.53 cents per pound.

The prices quoted above are those reported by the Singapore Chamber of Commerce and published by the Chief Statistician, Federation of Malaya.

The average prices paid for small-holders' rubber at three towns in the Federation of Malaya are given in Table I. Table II shows production figures.

Tea.—About 1,200,000 lb. of tea were produced in the Federation of Malaya in the January-March period. The average prices paid in London for teas from Malaya and other countries are shown in Table III.

Coffee.—Table IV shows Liberican coffee prices at two towns in Selangor.

Other Agricultural Products.— The production figures for palm oil appear in Table V and those for copra and copra products, in Table VI. Tables VII and VIII show the Singapore prices and pan-Malayan export figures for various agricultural products.

Table I

Average Monthly Prices Paid by Local Dealers for Small-holders' Rubber, January to March, 1957

(dollars per *pikul**)

Grades	Taiping, Perak			Seremban, Negri Sembilan			Batu Pahat, Johore		
	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
Smoked Sheet No. 1	108.22	99.57	104.73	108.06	99.35	104.03	—	—	—
Unsmoked Sheet ..	88.84	80.74	88.65	85.87	77.10	81.36	86.56	80.66	88.86
Scrap ..	40.66	41.64	45.08	53.75	49.43	52.26	28.80	28.04	32.27

* 1 *pikul* = 133⅓ lb.

This table has been compiled from statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION
FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1956	1957	1956	1957	1956	1957
January ..	32,515	36,076	26,428	27,184	58,943	63,260
February ..	27,503	27,002	23,848	21,998	51,351	49,000
March ..	28,408	25,908	22,433	20,915	50,841	46,823
April ..	26,591	26,501	21,647	22,460	48,238	48,961
May ..	23,389	27,129	19,703	18,305	43,092	45,434
June ..	29,409		23,109		52,518	
July ..	30,709		23,807		54,516	
August ..	30,201		22,927		53,128	
September ..	30,123		21,774		51,897	
October ..	30,386		22,455		52,841	
November ..	28,363		21,179		49,542	
December ..	34,636		24,058		58,694	
Total ..	352,233		273,368		625,601	
Total 1955 ..	351,802		285,281		637,083	

This Table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

Average Prices Paid in London for Tea

(s.d. per lb.)

For the Week Ending	Malayan	Ceylon	Indonesian	India		Africa
				Northern	Southern	
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
31.1.57	5 7.23	6 0.39	NIL	5 9.27	5 9.61	4 11.69
7.2.57	4 8.48	5 10.96	NIL	5 5.70	5 6.21	4 6.82
14.2.57	4 1.10	5 3.32	4 2.24	4 8.28	4 9.08	3 10.24
28.2.57	4 5.80	4 9.00	NIL	4 5.77	4 5.15	4 1.44
7.3.57	3 8.16	4 3.35	NIL	4 0.98	3 11.71	3 7.80
14.3.57	4 0.75	4 3.33	3 7.73	3 11.80	3 11.89	3 8.72
21.3.57	3 6.96	4 2.94	3 4.51	3 11.04	3 11.17	3 6.77
28.3.57	3 4.37	4 2.64	3 3.35	3 8.78	3 9.42	3 3.44

Prices taken from the Tea Brokers' Association of London Tea Market Report, supplied by Messrs. Wilson, Smithett and Co., London.

Table IV

Average Dealers' Prices for Dried Liberican Coffee Beans Grown in Selangor*

(dollars per *pikul*§)

For the Week Ending	Klang	Kuala Langat
	$	$
5.1.57	146.00	168.00
12.1.57	146.00	168.00
19.1.57	147.00	168.00
26.1.57	149.00	168.00
2.2.57	145.00	165.00
9.2.57	141.00	160.00
16.2.57	140.00	158.00
23.2.57	139.00	155.00
2.3.57	140.00	153.00
9.3.57	137.00	152.00
16.3.57	136.00	150.00
23.3.57	135.00	150.00
30.3.57	140.00	151.00

* These are not the prices paid to small-holders, who sell freshly-harvested berries to dealers for processing.

§ 1 *pikul* = 133⅓ lb.

Table V

PRODUCTION OF PALM OIL AND KERNELS

FEDERATION OF MALAYA

(long tons, as declared by estates)

Month	Palm Oil		Palm Kernels	
	1956	1957	1956	1957
January ..	3,712	3,527	1,038	921
February ..	3,697	3,572	1,013	926
March ..	4,520	4,828	1,229	1,225
April ..	4,105	4,585	1,079	1,168
May ..	4,364		1,096	
June ..	5,263		1,310	
July ..	4,977		1,210	
August ..	5,303		1,383	
September ..	5,098		1,285	
October ..	5,387		1,411	
November ..	4,842		1,233	
December ..	4,654		1,208	
Total ..	55,922		14,495	

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE

FEDERATION OF MALAYA

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates (a)		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
January ..	2,728	2,473	7,808	8,454	10,536	10,927	8,247	8,272	5,197	5,160
February ..	2,713	2,339	8,457	5,916	11,170	8,255	7,369	7,919	4,612	4,803
March ..	3,032	2,725	6,463	5,510	9,495	8,235	8,459	8,677	5,242	5,340
April ..	2,878	2,849	7,188	6,975	10,066	9,824	7,916	6,618	4,855	4,245
May ..	2,813		11,015		13,828		8,729		5,434	
June ..	3,133		9,457		12,590		9,193		5,731	
July ..	3,860		10,971		14,831		9,410		5,849	
August ..	4,140		14,000		18,140		11,447		7,132	
September ..	3,986		12,896		16,882		9,567		6,028	
October ..	3,807		10,605		14,412		9,403		6,263	
November ..	2,992		8,291		11,283		9,195		5,739	
December ..	2,927		7,894		10,821		9,438		5,726	
Total ..	39,009		115,045		154,054		108,373		67,808	

Notes:—1. The above table has been compiled fram statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

(a) Includes copra equivalent of sales of fresh nuts by estates.

Table VII

Singapore Prices of Various Agricultural Products

(dollars per *pikul*§)

Date	Copra, Sundried	Coconut Oil*	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1957								
7th Jan.	28.25	47.25	125.00	135.00	65.00	12.50	17.50	15.00
14th Jan.	28.75	43.50	118.50	128.50	65.00	12.375	18.50	15.00
21st Jan.	28.75	47.00	114.50	124.50	65.00	12.25	18.00	14.50
28th Jan.	28.50	46.50	108.00	118.00	65.00	12.25	18.50	14.50
4th Feb.	29.00	47.25	108.00	118.00	65.00	12.25	18.50	14.00
11th Feb.	28.50	47.50	102.00	112.00	65.00	12.25	17.50	14.50
18th Feb.	28.375	47.50	101.00	111.00	66.00	12.125	17.25	14.00
25th Feb.	28.50†	47.25	96.00	106.00	66.00	12.00	17.25	14.00
4th Mar.	29.00	47.00	96.00	106.00	66.00	12.00	17.25	14.00
11th Mar.	29.00	47.25	103.00	113.00	66.00	12.00	17.25	14.00
18th Mar.	30.875	47.75	102.00	112.00	66.00	11.75	17.00	13.50
26th Mar.	29.00	47.50	102.00	112.00	66.00	11.50	16.00	13.00

§ 1 *pikul* = 133⅓ lb.
* F.O.B. in second-hand drums.
† Nominal.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

Table VIII

MALAYAN AGRICULTURAL EXPORTS, OCTOBER TO DECEMBER, 1956

Product	Net Exports in Tons			
	Year 1955	Year 1956	Oct.-Dec., 1955	Oct.-Dec., 1956
Arecanuts ..	13,679	11,228	3,423	3,392
Coconuts, fresh ††‡ ..	72,140	34,779	2,204	2,095
Coconut oil ‡ ..	91,176	103,132	25,958	27,785
Copra ‡ ..	75,076 *	82,549 *	17,005 *	18,232 *
Copra cake ..	56,404 *	66,174 *	14,929 *	17,732 *
Gambier, all kinds ..	66	96	39 *	119 *
Palm Oil ..	52,832	55,252	13,285	17,763
Pineapples, canned ..	27,756	30,377	4,438	4,928
Rubber ¶ ..	673,083	625,601	168,668	161,077
Sago, flour ..	23,053	21,483	5,956	4,715
Sago, pearl ..	5,483	4,276	1,022	1,131
Sago, raw ..	18,709 *	18,522 *	4,370 *	5,544 *
Tapioca, flake ..	475	260	209	126
Tapioca, flour ..	3,979 *	3,753 *	772 *	949 *
Tapioca, pearl ..	5,470	5,630	1,260	1,397
Derris ..	13	3	3	—
‡ Copra equivalent ..	74,528	85,736	25,221	26,961

¶ production (Federation of Malaya). † hundreds in number. * net imports.

METEOROLOGICAL SUMMARY, MALAYA, FEBRUARY, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F.	° F.			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	93.8	70.9	82.3	98.1	68.4	88.6	73.2			2.36	59.9	1.11	8	6	2			237.60	8.49	
Kuala Lumpur, Selangor	90.9	71.7	81.0	94.1	67.7	83.0	73.9			5.58	141.7	2.87	6	5	3			222.10	7.93	
Sitiawan, Perak ..	90.4	71.3	80.9	93.0	68.8	87.0	73.1	84.2	84.9	1.55	39.4	1.20	3	3				232.75	8.31	
Kuantan, Pahang ..	86.7	68.9	77.8	89.2	64.8	82.0	72.0	80.6		4.47	113.5	1.75	11	8				200.80	7.17	
Bayan Lepas, Penang ..	89.5	73.3	81.4	91.3	70.4	85.6	77.4			1.19	30.2	0.52	5	5				249.00	8.89	
Malacca ..	89.7	72.6	81.1	94.0	68.0	83.0	75.7			3.95	100.3	2.76	3	3				220.60	7.88	
Mersing, Johore ..	83.8	73.1	78.5	85.6	68.7	81.3	77.0			1.25	31.8	0.46	8	6				219.30	7.83	
Alor Star, Kedah ..	92.7	70.4	81.5	95.2	65.7	86.4	73.8			2.30	58.4	1.50	6	5	1			253.65	9.06	
Kota Bharu, Kelantan ..	84.7	71.8	78.3	86.8	67.1	82.5	76.5	83.8	84.2	2.54	62.0	1.12	7	6		1		232.80	8.31	
K. Trengganu, Trengganu	83.8	71.7	77.7	85.9	68.2	79.0	75.8			7.67	194.8	2.70	9	8				221.85	7.92	
Singapore ..	87.6	73.0	80.8	91.4	70.6	82.4	76.0			2.89	73.4	0.82	9	9	2			206.50	7.37	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	73.2	52.6	62.9	75.8	45.8	65.0	59.8			5.38	136.7	1.53	11	9				180.40	6.44	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MARCH, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F.	° F.			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	92.8	72.9	82.9	97.3	70.0	86.2	77.5			16.10	408.9	3.88	19	17	7			212.35	6.85	
Kuala Lumpur, Selangor	91.0	73.4	82.2	94.4	71.1	85.4	77.0			9.76	247.9	1.60	22	18	17	5		193.25	6.23	
Sitiawan, Perak ..	90.9	72.5	81.7	95.3	70.7	86.9	75.8	84.7	85.5	1.75	44.5	0.72	12	9	1	2		186.35	6.01	
Kuantan, Pahang ..	87.3	70.3	78.8	90.6	65.8	77.8	75.4	82.5		8.02	203.7	1.85	15	12	3	5		177.80	5.73	
Bayan Lepas, Penang ..	89.9	74.7	82.3	93.6	72.0	84.3	76.9			1.53	38.9	0.49	10	8	1			208.00	6.71	
Malacca ..	89.9	73.8	81.9	94.1	72.0	84.4	75.1			3.84	97.5	0.94	12	10	2	1		194.85	6.29	
Mersing, Johore ..	85.6	72.5	79.1	87.9	67.5	81.8	78.2			9.10	231.1	2.54	14	12				220.80	7.12	
Alor Star, Kedah ..	94.1	72.0	83.1	98.3	67.6	86.6	75.5			2.39	60.7	0.84	10	9	3			232.35	7.49	
Kota Bharu, Kelantan ..	86.7	72.7	79.7	88.5	67.8	81.4	77.2	85.5	85.2	9.56	242.8	4.85	13	11	3	2		235.40	7.59	
K. Trengganu, Trengganu	85.0	72.2	78.6	88.0	68.6	77.0	75.6			11.60	294.6	3.58	13	11	3			216.90	7.00	
Singapore ..	88.4	74.2	81.3	92.0	72.5	83.7	77.2			5.23	132.8	1.24	15	12	9			178.45	5.76	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	74.2	52.6	63.4	79.0	45.9	68.0	60.6			16.49	418.8	2.27	20	20				116.75	3.77	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, APRIL, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F.	° F.			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	92.6	74.4	83.5	95.0	71.8	89.2	77.2			10.28	261.1	1.75	16	12	7			201.50	6.72	
Kuala Lumpur, Selangor	91.2	74.4	82.8	95.2	72.7	87.2	76.1			9.56	39.3	2.60	20	15	10	7		189.90	6.33	
Sitiawan, Perak ..	89.6	73.6	81.6	92.3	71.7	84.0	76.6	84.8	85.6	7.84	199.1	3.04	14	11	5			199.45	6.65	
Kuantan, Pahang ..	89.7	72.0	80.9	93.3	69.1	82.0	74.4	83.9		3.68	93.5	1.00	10	10	2	5		214.00	7.13	
Bayan Lepas, Penang ..	89.1	75.3	82.2	91.8	71.9	83.9	78.0			6.59	167.4	2.18	16	14	4			218.70	7.29	
Malacca ..	89.3	74.2	81.7	93.8	72.1	85.6	76.8			7.28	184.9	3.54	15	12	2			189.90	6.33	
Mersing, Johore ..	87.5	72.0	79.7	89.9	70.6	83.1	73.2			3.57	90.7	0.83	11	9				231.45	7.71	
Alor Star, Kedah ..	91.6	74.4	83.0	94.4	71.4	82.8	77.4			9.03	229.4	1.57	17	15	7			254.95	8.50	
Kota Bharu, Kelantan ..	90.0	74.8	82.4	93.0	73.0	86.8	76.3	89.8	87.4	0.59	15.0	0.33	5	4	2	1		281.70	9.39	
K. Trengganu, Trengganu	88.8	73.6	81.2	91.3	71.2	86.0	75.8			0.88	22.4	0.37	10	6				274.25	9.14	
Singapore ..	89.4	75.1	82.3	92.7	73.7	81.2	76.3			5.25	133.4	3.14	10	8				190.70	6.36	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	74.1	57.0	65.5	78.2	50.4	72.0	61.2			16.07	408.2	4.07	24	20				115.80	3.86	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	°F.	°F.			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	91.8	74.4	83.1	94.6	72.9	88.1	77.4			11.95	303.5	1.76	20	17	12			207.00	6.68	
Kuala Lumpur, Selangor	90.6	74.4	82.5	93.4	71.8	87.7	76.8			8.38	212.9	2.47	20	17	13	4		192.65	6.21	
Sitiawan, Perak ..	89.1	74.2	81.7	91.5	72.2	83.0	76.1	85.7	86.1	4.02	102.1	0.64	18	13	3	3		217.00	7.00	
Kuantan, Pahang ..	90.5	73.5	82.0	92.7	71.3	88.0	76.0	84.8		7.11	180.6	2.72	13	11	8	4		213.20	6.88	
Bayan Lepas, Penang ..	88.2	75.6	81.9	91.0	73.8	83.9	77.9			6.73	170.7	1.64	16	14	4			214.30	6.91	
Malacca ..	87.6	74.5	81.1	89.9	72.6	83.3	78.0			11.21	284.7	3.75	15	10	3			211.60	6.83	
Mersing, Johore ..	86.6	72.5	80.5	91.4	70.4	84.2	74.1			6.63	168.4	2.18	10	8	1			227.20	7.33	
Alor Star, Kedah ..	90.6	75.4	83.0	95.6	73.7	86.6	77.3			6.35	161.3	1.60	17	10	3			255.25	8.25	
Kota Bharu, Kelantan ..	91.0	75.4	83.2	93.4	73.0	87.0	77.8	90.4	89.6	4.25	108.0	2.26	8	5	5			261.95	8.45	
K. Trengganu, Trengganu	90.9	74.1	82.5	93.6	72.6	85.0	76.0			0.69	17.5	0.26	5	5				268.35	8.66	
Singapore ..	87.7	75.3	81.5	91.3	73.1	82.0	77.1			5.62	142.7	1.18	15	12				165.10	5.33	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	74.3	57.4	65.9	77.6	52.4	70.1	61.4			12.32	312.9	1.45	30	29				116.75	3.77	

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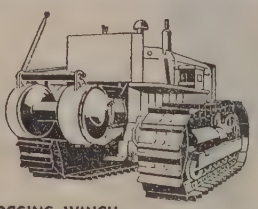

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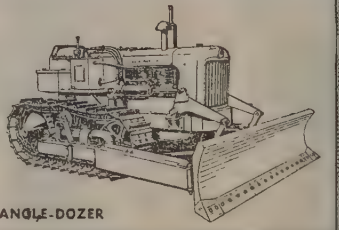

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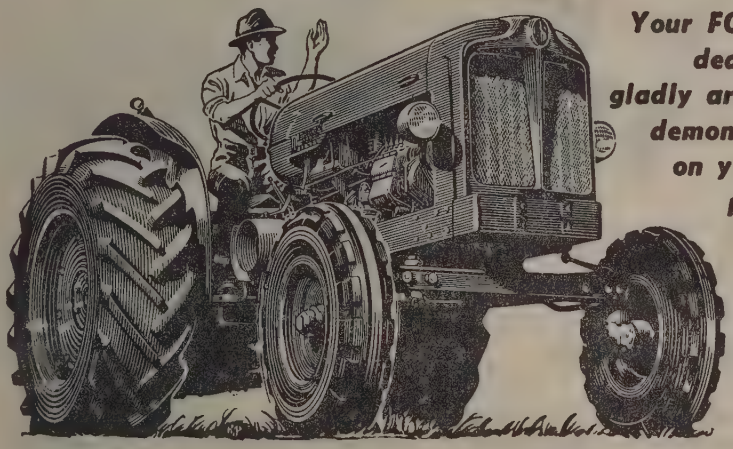

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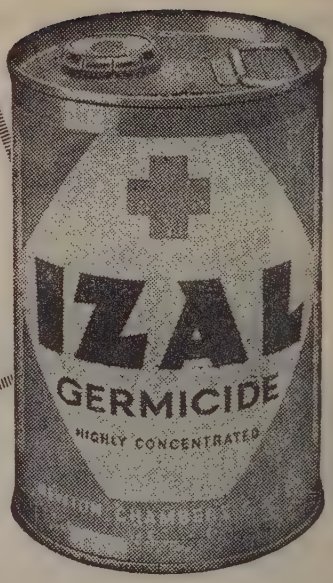

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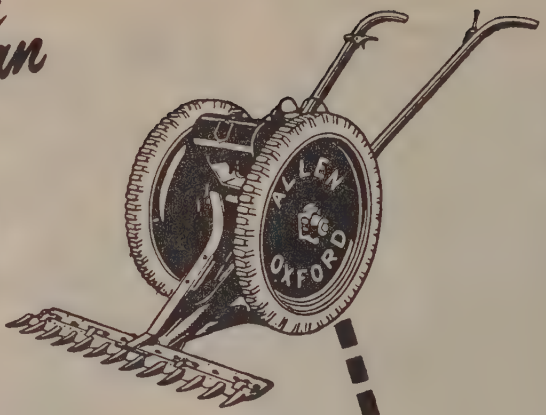

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Other publications of the Department of Agriculture are listed in the inside back cover of this issue.

* Compiled from the Classified Index to the **Malayan Agricultural Journal** which was mailed free to subscribers in 1955.

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DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA

The Director of Agriculture invites those interested to visit the College of Agriculture, Serdang, Selangor, and the various Federal and State/Settlement Stations throughout the Federation of Malaya. Intending visitors to the College of Agriculture should communicate with the Principal; to the Federal Experiment Station, Serdang, Selangor, with the Agronomist-in-charge; and to other Federal and State/Settlement Stations with the State/Settlement Agricultural Officers. The following is a list of Agricultural Stations on which can be studied the more important lines of investigation and extension at present carried out by the Department.

Correspondence concerning the experiments at any of these Stations should, if it originates in Malaya, be addressed to the State/Settlement Agricultural Officer concerned; correspondence originating in any other country should be addressed to the Director of Agriculture, Federation of Malaya, Kuala Lumpur.

Wet Padi.

SELECTION WORK. Telok Chengai, Kedah; Titi Serong, Simpang Tiga and Talang, Perak; Pulau Gadong, Malacca; Kota Bharu and Jelawat, Kelantan; Kendong, Ulu Klawang and Ampang Tinggi, Negri Sembilan; Sungei Burong and Panchang Bedena, Selangor; Genting and Bukit Merah, Penang and Province Wellesley; and other State/Settlement Stations.

AGRONOMIC INVESTIGATIONS. Most Padi Experiment and Test Stations.

Dry Padi.

Melor, Kelantan, and Paya Besar, Pahang.

Rubber.

Budwood and clonal seedling nurseries. Most State/Settlement Agricultural Stations. Replanting demonstration plots in all States and Settlements.

Tea.

Federal Experiment Station, Cameron Highlands.

Oil Palm.

Federal Experiment Stations, Serdang, Selangor, and Jerangau, Trengganu.

Coconut.

Federal Experiment Station, Telok Bharu, Perak, and Coconut (Rehabilitation) Station, Sungei Sudah, Muar, Johore.

Cacao.

FEDERAL EXPERIMENT STATIONS. Serdang, Selangor; and Jerangau, Trengganu.

AMELONADO SEED GARDENS. Sik, Kedah; Batang Merbau, Kelantan; Sungei Tong, Trengganu; Ayer Itam, Penang; Layang Layang Kiri and Bukit Gantang, Perak; Temerloh, Kuala Lipis and Pekan, Pahang; Ampang Tinggi, Negri Sembilan; Sungei Udang, Malacca; Ayer Hitam, Johore.

Pineapple.

Jalan Kebun, Selangor, and Alor Bukit, Johore.

Manila Hemp.

Federal Experiment Station, Serdang, Selangor; Degong, Perak; and Sungei Ruan, Pahang.

Fruit Propagation.

All State/Settlement Agricultural Stations.

Vegetables.

Federal Experiment Stations, Kuala Lumpur and Cameron Highlands.

Poultry.

Cameron Highlands and most State/Settlement Agricultural Stations.

Livestock.

PIGS: Cameron Highlands; Sungei Buloh and Jenjarom, Selangor; Mah San, Negri Sembilan; Sg. Siput, Perak; Pulau Gadong, Malacca; Ayer Itam, Penang; and Ayer Hitam, Johore.

GOATS: Federal Experiment Station, Serdang, Selangor; Chembong, Negri Sembilan; and Ajil, Trengganu.

Pastures.

Federal Experiment Station, Serdang, Selangor.

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